GENERAL LIBRARY
SEP 20 1913
UNIV. OF MICH.

SIXTY-NINTH YEAR

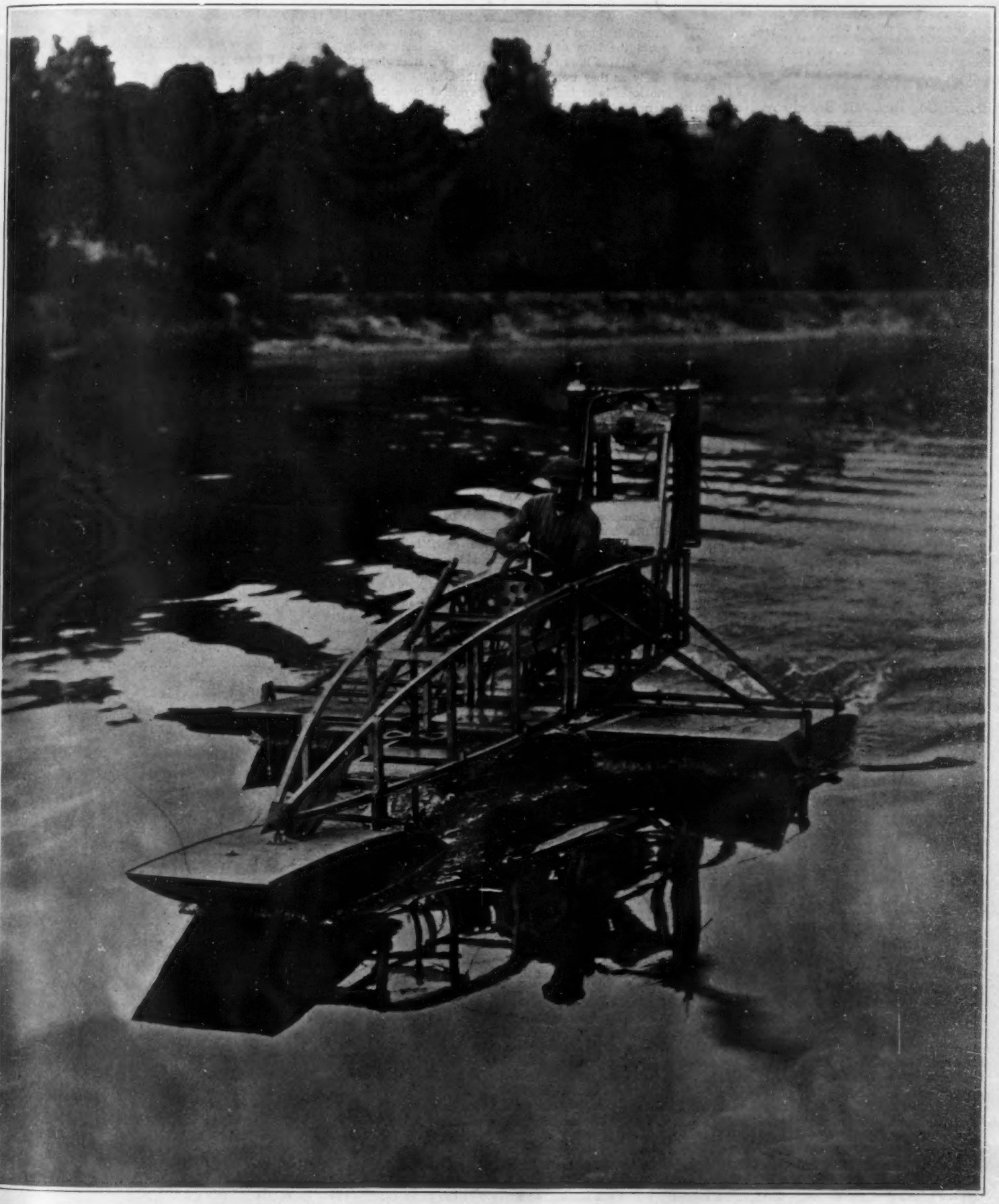
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CIX
NUMBER 12.

NEW YORK, SEPTEMBER 20, 1913

PRICE 10 CENTS
$3.00 A YEAR



THE TELLIER HYDROPLANE, WHICH IS DRIVEN BY AN AIR PROPELLER AT A SPEED OF 43 MILES AN HOUR.—[See page 229.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, SEPTEMBER 20, 1913

Published by Munn & Co., Incorporated. Charles Allen Munn, President
Frederick Converse Beach, Secretary and Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Copyright 1913 by Munn & Co., Inc.

Subscription Rates

Subscription one year $3.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid. 3.75

The Scientific American Publications

Scientific American (established 1845) . . . . . per year, $3.00
Scientific American Supplement (established 1876) . " " 5.00
American Homes and Gardens . . . . . " " 3.00

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Sir Oliver Lodge's Address

So much emphasis has been laid by the daily press on the few generalizations affecting psychical research which Sir Oliver Lodge embodied in the conclusion of his presidential address before the Birmingham meeting of the British Association for the Advancement of Science, that the profoundly philosophical and critical estimate of modern scientific achievements to which the major portion of the address is devoted is apt to be overlooked. To those of our readers who take an interest in this present transition period of physics, chemistry and biology we would commend a careful reading of Sir Oliver Lodge's text as it appears in the current number of the SCIENTIFIC AMERICAN SUPPLEMENT. Noteworthy as most of the presidential addresses delivered before the British Association have been, Sir Oliver's unquestionably stands forth as one of the most pregnant utterances that have come from the lips of a scientific man in a decade.

Surveying as from a mountain top with the unclouded eyes of a seer, the battlefield on which the new science is waging a conflict with the old, Sir Oliver characterizes the scientific period in which we live as one of fundamental skepticism—not the theological skepticism of old, but a deep-rooted skepticism which has all but undermined the long established foundations of science. Scientific men are beginning to ask whether the conservation of energy is always and everywhere valid, whether the second law of thermodynamics is not somewhere disobeyed, whether the long known and well-established laws of mechanics hold true everywhere and always, and whether the Newtonian scheme must not give place to something more than a mere approximation to real conditions. Indeed, it is argued by the new school that we have no faculty for ascertaining real truth. What we once regarded as statements of fundamental, unassailable truth are now regarded as conventions useful only as quasi-explanations.

Against this enshrining of vagueness as an idol to be worshiped, Sir Oliver protests. Much of it was brought about by the tendency to resolve everything into atoms. In that tendency Sir Oliver sees danger—the danger that scientists may lose all sense of the continuity of nature. His whole address is therefore a plea for continuity.

In proclaiming himself "an upholder of *ultimate* continuity and a fervent believer in the ether of space" Sir Oliver Lodge makes a strong attack not upon recent scientific discoveries, but rather upon those comprehensive negative generalizations from a limited point of view, which are based on such experiments as those of Michelson and Morley on the velocity of light.

He is thus led to decry the principle of relativity. "If the principle of relativity in an extreme sense establishes itself, it seems as if even time would become discontinuous and be supplied in atoms, as money is doled out in pence or centimes instead of continuously; in which case our customary existence will turn out to be no more really continuous than the events of a kinematograph screen, while that great agent of continuity, the ether of space, will be relegated to the museum of historical curiosities." That would indeed mean "the most fundamental revolution since Newton."

Sir Oliver protests against the present denial of the existence of anything which makes no appeal to organs of sense and no ready response to laboratory experiments. While all the laws of chemistry and physics may be applied without hesitation in the organic domain, Sir Oliver seems to question whether they are sufficient. There can be no doubt that a living thing, while it obeys the laws of physics, also initiates processes and produces results that, without it, could not have occurred. "The behavior of a ship firing shot and shell," as Sir Oliver picturesquely puts it, "is explicable in terms of energy, but the discrimination which it exercises between friend and foe is not so explicable." No mathematician could calculate the orbit of a common housefly. "A physicist into whose galvanometer a spider had crept would be liable to get phenomena of a kind quite inexplicable, until he discovered the supernatural, i. e., literally superphysical cause." Accordingly Sir Oliver risks the assertion that "life introduces something incalculable and purposeful amid the laws of physics; it thus distinctly supplements those laws though it leaves them otherwise precisely as they were, and obeys them all." He can see no logic in trying to explain psychical phenomena in terms of physics and chemistry. There is a deeper meaning involved in natural objects than can be explained by the laws of physics and chemistry. "Flowers attract insects for fertilization; and fruit tempts animals to eat it in order to carry seeds. But these explanations cannot be final. We have still to explain insects. So much cannot be necessary merely to attract their attention. We have further to explain this competitive striving toward life. Why do things struggle to exist? Surely the effort must have some significance, the development some aim." Scientific men are too prone to confine themselves to the mere machinery of existence. Because that machinery obeys all the laws of chemistry and physics, Sir Oliver finds that scientific men are blind to its other functions. "Science may not be able to reveal human destiny, but it certainly should not obscure it."

Taming the Chagres River

When the United States Government entered upon the construction of the Panama Canal, it was realized that the most difficult physical problem confronting our engineers was the turbulent Chagres River. A shallow and gently flowing stream in the dry season, the Chagres, fed by the heavy rains of the wet season, is liable to become transformed within a few hours into a mighty torrential river, with a flow comparable to that which passes over Niagara Falls. The canal runs approximately north and south; the Chagres, flowing from the east, intersects the canal, approximately at its mid-length, and, at the point of intersection, turns somewhat abruptly to the north and flows in a course generally parallel with the canal, to discharge into the Atlantic Ocean.

Manifestly, any plans for the building of the canal had to make ample provision for controlling these stupendous flood waters and guiding them safely to the sea. Under the plans for a sea level canal under the French *régime*, and later as proposed by the minority report of the International Board of Engineers, it was proposed to construct, parallel to the canal, a large artificial channel, capable of carrying the Chagres floods clear of and without interference with the work of excavation—a stupendous and hazardous problem in itself. Under the plans for the lock canal as now practically completed, the bold project was conceived and successfully carried through of building an enormous dam across the Chagres Valley near its Atlantic end, and providing at its center a spillway opening, through which the flood waters could pass unobstructed to the Atlantic. Taking advantage of the dry seasons when the flow of the Chagres is insignificant, this spillway opening has been gradually closed by a dam of solid concrete, provided with suitable openings controlled by gates, through or over which the flood waters have passed in the rainy season. At the present writing the spillway gates are closed, and the once greatly-dreaded Chagres, transformed from foe to friend, is performing its quota of the work of canal building by the formation of a vast inland lake, nearly 170 square miles in extent, which will afford some 20 miles of deep water navigation across the Isthmus.

Those of our readers who have had the good fortune to visit the Panama Canal during its construction will doubtless remember that when they reached the northern end of the Culebra cut, the train passed over a steel bridge about a quarter of a mile or more in length, which served to carry the tracks across a rather broad and shallow stream. This stream is the Chagres River, and the point of crossing is located where the Chagres makes its swing around to the north on its way to the Atlantic Ocean. In times of flood, the Chagres at this point has stood at an elevation of eighty feet or more above sea level. The surface of the canal through the lake and Culebra cut will be 85 feet above sea level, and since the bottom of the canal will be 45 feet below this, it follows that unless some provision had been made for preventing the floods from entering the Culebra cut, the latter would have been filled during the flood season with from 30 to 40 feet of water during the time of maximum rise. To prevent this an artificial embankment, known as the Gamboa dike, was built from the railroad embankment across the axis of the canal to the opposite side of the valley; and this dike has served to keep the cut dry during the progress of the excavation. The drainage of the cut has been removed by means of four twenty-six-inch pipes laid through the bottom of the dike, through which the water has been drawn by a pumping plant constructed specially for that work.

On September 15th all steam shovel work was suspended in the Culebra cut, and the construction outfit, steam shovels, drills and over thirty-six miles of track, is now being removed from the cut, preparatory to flooding it with water. The last work of the drills was to prepare for blasting the six or seven hundred thousand cubic yards remaining to be taken out of the bottom of the cut. This material will be removed by floating dredges, when the cut has been filled with water. Half a dozen steam shovels will be maintained at work on the east bank and four on the west bank, removing the top material so as to decrease the load and diminish the tendency of the banks to slide into the canal.

The plan of operation for filling the cut is as follows: First, on October 5th, the four 26-inch drain pipes through the dike will be opened, and the water from Gatun Lake, which on August 23rd stood at 59.1 feet above sea level, will be permitted to flow into the cut for five days or until October 10th; on which day the Gamboa dike will be dynamited and the nine miles of cut extending from the dike to the upper lock gates of Miraflores will be filled to the level of the lake.

The final act in this great engineering drama will be played by the two enormous floating dredges, the largest ever built, which have been constructed for the purpose of wrestling with the gigantic slides of the Culebra cut. They will first clear up what remains of the *débris* of the Gamboa dike, and then, proceeding through the cut, they will remove the broken rock of the final blasting above referred to. Having done that, they will attack the huge slides which have been giving so much trouble, particularly during the past four or five years. These dredges have a combined capacity of 1,200,000 cubic yards per month, and they are therefore well qualified for their task of removing the 9,000,000 cubic yards of slides that are now moving into the prism of the canal.

And thus the world's greatest work of engineering will have been completed one year ahead of the time estimated by the engineers.

"Smoke-proof" Buildings

A fireman of long and varied experience in the service of the New York city Fire Department recently stated that of the bodies recovered from burned buildings, a surprisingly large number showed no visible effect even of being slightly scorched by the flames, which means, of course, that a large proportion of the fatalities are due to simple asphyxiation. In the Park Avenue Hotel fire of some ten years ago, most of the guests who lost their lives were found, if we remember rightly, without a visible mark of fire upon their persons or clothing.

So far as the fatal effects are concerned, the poisonous gases that accompany smoke are as deadly to human life as flame. Hence, if the lives of the inmates of a tall office building are of greater value than the structure itself, we should take greater pains to protect human life against asphyxiation than we do to protect the steel and masonry building against fire. But to secure both of these results, it is necessary, not merely to construct the building itself of incombustible material, but to see to it that everything of a combustible nature in the way of fittings and furnishings be most rigidly excluded. If the tons of wooden furniture in the lower stories of a three or four hundred foot high building were ablaze, and the products of combustion, the smoke and gases, were sweeping upward through stairways and elevator shafts and filling the various corridors, what earthly chance would the inmates of the upper stories have of getting out of the building before they were overcome by suffocation?

All of which considerations give great force to the protest which has recently been made by Mr. A. G. Patton, manager of the Special Hazards Department of the New York Fire Insurance Exchange, against the plan of the Board of Estimate to equip our new municipal building with wooden office furniture. We have buildings from four hundred to seven hundred feet and more in height in this city to-day. They are fireproof, that is to say, incombustible, it is true; but what about their contents?

By all means let the Board of Estimate rescind its action and provide for making our municipal building fireproof not only in itself, but as to its contents.

Engineering

Enormous Traffic on the New York Subway.—The total number of passengers carried last year by the Interborough Rapid Transit Company on the New York Subway and Elevated roads was 634,316,516, an increase over the previous year of over 27,000,000. The greater part of this increase was on the Subway, and it was due, principally, to the ten-car express service. The gross revenue for the year ending June 30th last was some thirty-two and one-half million dollars, an increase over the previous year of over one and one quarter million dollars.

Edinburgh Adopts Self-driven Street Cars.—After a careful study of the motor 'buses and cars of Paris and London, the Edinburgh City Council has been advised by its own Commission to adopt self-propelled street cars in preference to a system either of overhead or of conduit street car service. The Commission reports in favor of gasoline-electric cars, on the ground that the first high cost of these is more than counterbalanced by the great cost of installing an overhead or underground trolley system.

The Railways in the United States.—According to the statistics of the Interstate Commerce Commision for the fiscal year ending June 30th, 1912, there are 240,238 miles of track operated in the United States. The average number of locomotives per 1,000 miles of line was 265, and the average number of cars was 9,860. The total number of persons on the payrolls was 1,699,218, and the total wages and salaries paid amounted to $1,243,113,172. The par value of the amount of railway capital outstanding was over nineteen and one half billio dollars.

Statistics of Railway Accidents.—The report of the Interstate Commerce Commission shows that during the months of October, November, December, 1912, 260 people were killed and 4,334 were injured in train accidents. Casualties of all classes amounted to 2,967 killed and 61,323 injured. The total number of collisions and derailments for this quarter compared with those for corresponding quarters of the four previous years shows that with the exception of 1911, the number has increased, there being for the current quarter an increase of 48.8 per cent over the corresponding quarter of 1908.

A Herreshoff Yacht for the Defense of "America's" Cup.—We shall not be surprised if the reduction in the size and cost of cup defenders for the races of next year results in the construction of several yachts to contend for the honor of being selected for the defense of the cup. We are pleased to note that Herreshoff, who has contributed so greatly to the retention of the cup in this country in past years, has been commissioned to build a 75-foot defender for a syndicate composed of former Commodore Cornelius Vanderbilt of the New York Yacht Club, J. P. Morgan and Frederick G. Bourne. As usual, Herreshoff has been given a free hand in the matter of the design of the yacht and its cost.

That Revolving Ship Again.—The revolving ship is one of those inventions which, although they are obviously impracticable, seem to have a fascination for the inventor which is rather difficult to explain. Several years ago there was built and tried in this country a boat of the revolving type which, if we remember rightly, reached a stage at which it was launched and an attempt was made unsuccessfully to propel it. According to a dispatch from London, a Paris inventor is now busy upon another of these craft, and judging from the meager descriptions available, the designer is following along the lines that were proved to be altogether impracticable fully a dozen years ago.

A New York Central Safety-Exhibit Car.—A safety-exhibit car, for use in connection with the work of the safety department of the New York Central Lines, has recently been put in service. It will serve as an instruction car, in teaching the principles of "safety first" to the employees of the railroad. Along each side of the car are models of the machines used in the different shops to safeguard the workmen against injury. By means of photographs arranged on the walls, the "safe" and the "unsafe" methods of doing various kinds of work are depicted. Other framed pictures show how it comes about that, annually, over 10,000 trespassers are killed and injured on the railroads in the United States.

German Dreadnoughts to Carry 15-Inch Guns.—It seems to be pretty certain that the latest German dreadnoughts will be armed with 15-inch guns. If so, the German battleships will lead the world in the power of the individual units of their main batteries. The earliest German battleships, corresponding in date to our "Oregon," were armed with a gun of only about 9½ inches caliber. The next advance was to an 11-inch piece; then to a 12-inch, which is the gun with which the ships of the current program are being armed. The increase to a 15-inch piece will be much larger than the mere enlargement of caliber would indicate to the lay mind; for whereas our own 12-inch gun fires a shell weighing some 870 pounds, the shell for the 15-inch gun will be probably about 1800 pounds in weight.

Science

The Prince of Monaco, well known for his researches as an oceanographer and as a patron of science, has announced his intention of paying a visit to some of the principal scientific institutions of the United States in September.

A Deep Boring in Bermuda is furnishing interesting information concerning the geology of that island group. The boring was undertaken by the management of the Princess Hotel, Hamilton, in the vain hope of finding water "of volcanic origin," as the present local supply is mainly rain water, caught from the roofs of houses and stored in cisterns, and is inadequate. A depth of over 1,400 feet has been reached. Samples of rock, etc., have been taken at various depths, and one set of these has been presented to the United States National Museum in Washington. Petrographic studies of the material are being made by Messrs. L. V. Pirsson and T. W. Vaughan, while Mr. J. A. Cushman is studying the foraminifera for a report on the paleontology.

Metcalf's Comet.—A telegram received at Harvard College observatory from Prof. A. O. Leuschner, of Berkeley, Cal., gives the following elements and ephemeris of Metcalf's comet, computed by Prof. Crawford and Miss Levy, from observations on September 2nd, 3rd, and 4th:

EPHEMERIS.

G.M.T.	R.A.	Dec.	Light.
1913 September	h. m. s.	deg. m.	
7.5	6 41 39	+59 53	1.20
11.5	6 30 52	62 57	
15.5	6 12 28	66 41	
19.5	5 37 43	71 08	2.34

The comet's perihelion passage occurred on September 14th.

The Harmattan is a dry north to east wind that blows in winter on the upper Guinea coast in Africa. While it prevails the air is filled with fine dust. The characteristics of this wind are most easily explained on the supposition that it comes from the Sahara Desert, and is analogous to the "gibli" of Tripoli. However, the extensive burning of grass which goes on at the harmattan season might account for the remarkable dustiness of the wind. In order to help elucidate the origin of this wind, Capt. von Seefried, stationed in Togo, has recently collected specimens of harmattan dust with the aid of aspirators and filter-tubes. These were examined in Berlin and found to consist mainly of siliceous fragments of diatoms, indicating a desert origin. Vegetable ash was present, but evidently the burning grass merely intensifies the initial dustiness of the harmattan.

Natural History Manuals for the Philippines.—Travelers with a taste for natural history who visit the Philippines will do well to equip themselves with some of the excellent manuals published by the Bureau of Science in Manila. These include "A Flora of Manila" which is practically a complete flora of the settled areas at low altitudes throughout the archipelago, containing descriptions of over 1,000 species, with artificial keys, selected native, Spanish and English names, and accounts of habitats, time of flowering, and range of all species considered; "A Manual of Philippine Birds," containing descriptions of all known species of Philippine birds, with the usual keys for the benefit of the novice, native and English names, information as to range, and in many cases notes on nesting, migrations, and other habits; also "A List of the Mammals of the Philippine Islands, exclusive of the Cetacea," and "A Check-list of Philippine Fishes."

Human Geography and Industry-planning.—In a paper presented before the Birmingham meeting of the British Association for the Advancement of Science, Mr. C. R. Enock maintained that the economic problems before the world at the present time call for the establishment and exercise of a comprehensive and constructive science, whose aim would be to evolve and teach the principles under which economic equilibrium in the life of communities may be attained. It was argued that the real science of living on the earth, or "human geography," the adaptation of natural resources and national potentialities to the life of the community, has never been formulated. The congestion of the population in towns, the desertion of the countryside, the high cost of living, low wages, unemployment, and so forth, are related phenomena, intimately connected with the conservation and development of natural resources. The axiom was advanced that the world is capable of supporting all its inhabitants in sufficiency, and its failure to do so is due to the non-emergence so far of an organizing science, whose deliberations would be aloof from egoistic or partisan influences. It was affirmed that the teaching and operations of such a science is necessary if social security is to be maintained and civilization advanced; and it was suggested that to give effect thereto an institution should be established which would bear the same relation to the science of living as their corresponding institutions do to physical, geographical, medical, and other sciences.

Automobile

Two Automobile Shock Absorbers.—Two patents, Nos. 1,066,919 and 1,066,920, to Theo. A. Klenke of New York city and Frank N. Roehrich of Jersey City, N. J., assignors to Klenke Cushion Axle Company of New York city, provide pneumatic cushions supported upon the axles and operating to cushion the vehicle.

Automobile Starter and Lighter.—In patent No. 1,065,959, Morris Moskowitz, of Montclair, N. J., shows a motor vehicle in which the speed of the motor generator can be substantially the same as that of the crank shaft when the motor generator is driven by the engine as a generator to charge the batteries. The power of the motor generator can be gradually applied to the crank shaft during the starting of the engine.

One Hundred Horse-power Gun Wagons for Austrian Army.—New 12-inch siege mortars of the tubular-recoil pattern, with the tube 14 feet in length and equal to projecting an 800-pound shell nearly 6 miles and to a vertical distance of 2½ miles, just have been introduced into the Austrian army. Two of them will constitute a battery and with their ammunition, etc., will be transported on three motor trucks. The trucks are of the four-wheel drive pattern with an arrangement for driving either the forward or the rear pair of wheels or both. The engines develop 100 horse-power at the nominal speed of 800 revolutions a minute. To assist the vehicles over heavy ground, they are equipped with winches operated by the motor, and in addition each hauls at least one special winch wagon in which the winch is operated by the engine for working the guns into difficult positions.

Another Spring Wheel.—On account of the unavoidable, inherent disadvantages of the ordinary type of pneumatic automobile tire, designers have been striving for several years to bring forth a tire with puncture-proof qualities, yet retaining the necessary resiliency to afford desirable riding qualities. To this end one wheel manufacturer in particular claims to have solved the problem and will place his product on the market this month. The fundamental idea of the wheel is the carrying of the load on horizontal helical springs connected alternately to the outer and inner rims with ball and socket connections. There are 14 of these springs arranged around the periphery of the wheel rim in such a manner that each spring carries 1/14 of the total load on the wheel. When the car strikes an obstruction the shock is communicated through the solid rubber tire and is taken up by the reaction of the helical springs. The center of the wheel is made in the same way as any ordinary automobile wheel but its lateral strength is increased, since the spokes are much shorter than in the usual construction.

Meaning of Standardization to the Individual Motorist.—Unfortunately, the doings of the Society of Automobile Engineers are not advertised as widely as they might be advertised and as a result there are few who appreciate the true meaning of the society's activities to the individual owner. One of its latest accomplishments, for example, is the standardization of magneto mountings. The mere statement may mean next to nothing to the uninitiated but a little deeper delving brings to light its advantages. It means, briefly, that if John Smith is not satisfied with the magneto on his machine he may substitute for it another of a different make simply by removing it and placing the new instrument in its place; no expensive alterations will be necessary nor will the services of an expert be required. Of course, magnetos are not the only things the S. A. E. has standardized, though they are one of the most important. Bolt and screw threads also have been standardized and the importance of this step to the individual owner lies in the fact that he may now purchase at almost any hardware store or country general store a standard thread nut to replace one lost on the road. It no longer is necessary to send possibly thousands of miles away and to wait weeks for a nut or bolt—and then to pay for it in proportion.

The British Truck Show.—While this country has her motor truck shows every year and in almost every city of importance, England follows the policy of exhibiting only every half decade. In the British Commercial Motor Vehicle Show, which recently closed, at Olympia, the first in five years, the keynote was obviously progress. On account of the infrequency of these exhibits this is probably pointed out more forcibly than is done at our own annual truck displays. England has awakened to the fact that the United States has gained the upper hand in the production of pleasure cars and even in the disposal of them in her own country, and it is well for her own sake that she also recognizes the great progress that has been gradually taking place in the development of the commercial vehicle. The Olympia exhibit pointed out that the truck is no longer a crude device roughly put together, but that it is a finished product emerged from the experimental stage to take an important place in the world of commerce. And many authorities believe that the surface of truck development has been only scratched and that the next decade will see development that will bring a different and better vehicle.

The Steel Car as a Life Saver

Telescoping is Prevented by All-Steel Construction

IN the recent wreck on the New Haven Railroad, the heavy colliding engine and train split entirely apart the two rear wooden sleeping cars of the train ahead, scattering the wreckage and the helpless passengers to right and left as it crushed its way through. Over a score of people were killed outright.

It is begging the question to say that had the cars been of all-steel construction, none of these lives would have been lost; but there is abundance of evidence, drawn from the behavior of steel cars under conditions practically as severe as these, to show that steel construction would have saved the lives of many, if not of the greater part, of the occupants of these two rear cars.

In the event of a heavy collision, wooden cars fail, either by going entirely to pieces as in this case, or by one of the massive and strong underframes mounting upon another, and shearing the superstructure of the lower car entirely from its base. Wooden construction has the disadvantage that, although its strength to resist the first shock is great, once it has given way it offers but little progressive resistance to the crushing and rending energy of the collision; whereas the tough metal of which steel cars are built, not only offers a much greater resistance to the first shock, but, after the car or cars have begun to give way, the material still puts up a stubborn fight to retain its original form.

The behavior of trains of steel cars in collisions shows that the end platforms and vestibules, which are not or should not be occupied by the passengers when the train is in motion, form a natural buffer and "yield-point," and that the first energy of the collision, and generally the whole of it, is expended in crumpling up the vestibules—furthermore, this usually occurs without any loss of life.

Although the steel car will save its inmates from the crushing injuries which result in more or less speedy death, it cannot safeguard them from the contusions due to the sudden arresting of the train and the hurling of the passengers forward or backward, according as they are in the train which strikes or the one that is run into.

These facts are brought out in a report of the Interstate Commerce Commission on the wreck at Tyrone, Pa., on July 30th, on the Pennsylvania Railroad, in which, although 153 people were more or less injured, only one was killed. This collision was an almost exact duplication of that at North Haven on the New Haven Railroad. A train standing on the track was struck in the rear by a fast train. Not one car in either train was of wooden construction, and the only damage resulting was the crushing in of the vestibules. The heaviest damage, of course, was done to the rear car, which was crushed for ten or twelve feet in the rear, while the forward end was jammed for six or eight feet into the rear of the car ahead. Subsequently to the New Haven wreck, a fast train was ditched near Wylie's station on the Pennsylvania Railroad on September 9th, and although six steel coaches were flung from the track and turned over in a cornfield, only 35 persons were injured and none was killed.

By way of showing the great resistance afforded by steel construction, we present the accompanying illustrations of a wreck which occurred in July of this year on the tracks of the Northern Pacific Railway in the State of Washington, in which three passengers and one employee were killed, and seven passengers were injured. The train consisted of a 200-ton engine, followed by three refrigerator cars, one combination baggage and express car, three day coaches, one dining car, one Pullman sleeping car and one observation car, making ten cars in all. The train which was making up lost time jumped the track when it was running at a speed of sixty miles an hour. The engine rolled over into a gravel embankment, and the whole train was brought so suddenly to a stop, that the shock was not much less severe, probably, than that of a direct collision. The forward truck of the first steel day coach was knocked from beneath the car, allowing the forward end to drop and causing the rear end of the car ahead to mount the underframe and crush in the left-hand side of the car to the extent shown in our illustration.

When we remember that this 15 or 20 feet of the car had to absorb the enormous energy of the six rear cars, running at 50 to 60 miles an hour, the great resistance of the steel construction will be evident.

Derailment of a ten-car passenger train running at a mile a minute.

This steel car bore the brunt of a wreck at 60 miles per hour.

The Meteorological Service of Australia

BEFORE their federation, each of the Australian states had its own meteorological service, in most cases in connection with an official astronomical observatory. Some of these institutions made

Looking forward from the roof of the dining car.

weather forecasts and even published weather maps, but the work suffered from lack of co-ordination between the states, and was but meagerly supported by the several governments. The main outcome of these rather desultory efforts was the collection of a considerable body of climatic statistics.

In 1907 a general service was established for the whole commonwealth, with headquarters at Melbourne, and placed under the direction of Mr. H. A. Hunt, who still holds the post of "Commonwealth Meteorologist." Mr. Hunt's first important official act after his appointment was to make the circuit of the globe, visiting kindred institutions in other countries and picking up ideas. Since his return to Australia practical meteorology has made great progress in that part of the world.

Observations made every morning at 9 o'clock at four hundred and forty-two stations are transmitted to Melbourne by telegraph. Besides reports from places in the commonwealth, valuable advices are received from Cocos Island in the west, Macquarie Island (midway between Australia and the Antarctic) and New Zealand to the southwest, New Caledonia and Norfolk Island to the east, and Batavia to the north. Thus the total area embraced in the weather charts, which are published both in separate broadside form and in the daily newspapers, as in the United States, is scarcely inferior to that shown on United States weather maps. The ocean area is now pieced out to some extent with wireless reports from vessels, which also receive storm warnings by wireless from Melbourne.

In its method of preparing forecasts the Australian service is unique. Several forecasters work together at the central office. Most of these have had experience as local forecasters in one or another of the states, and each is regarded as an expert for his own district. However, each of them writes out forecasts for all the states, and these are submitted to the commonwealth meteorologist, who prepares an independent series of forecasts of his own. A conference is then held between Mr. Hunt and his staff, and the forecasts that ultimately go out represent the consensus of their opinions. During the year 1912 about 87 per cent of these predictions were verified.

As to particular phases of the work, there is a special service of warnings for the northwest coast of Australia during the willy-willy season, between November and April, and another for the drying season in connection with the fruit settlements at Renmark and Mildura, on the River Murray, analogous to that which the United States Weather Bureau maintains in California. A flood-warning service is also maintained, especially in Queensland, where the rivers are short and torrential.

What is Coca?

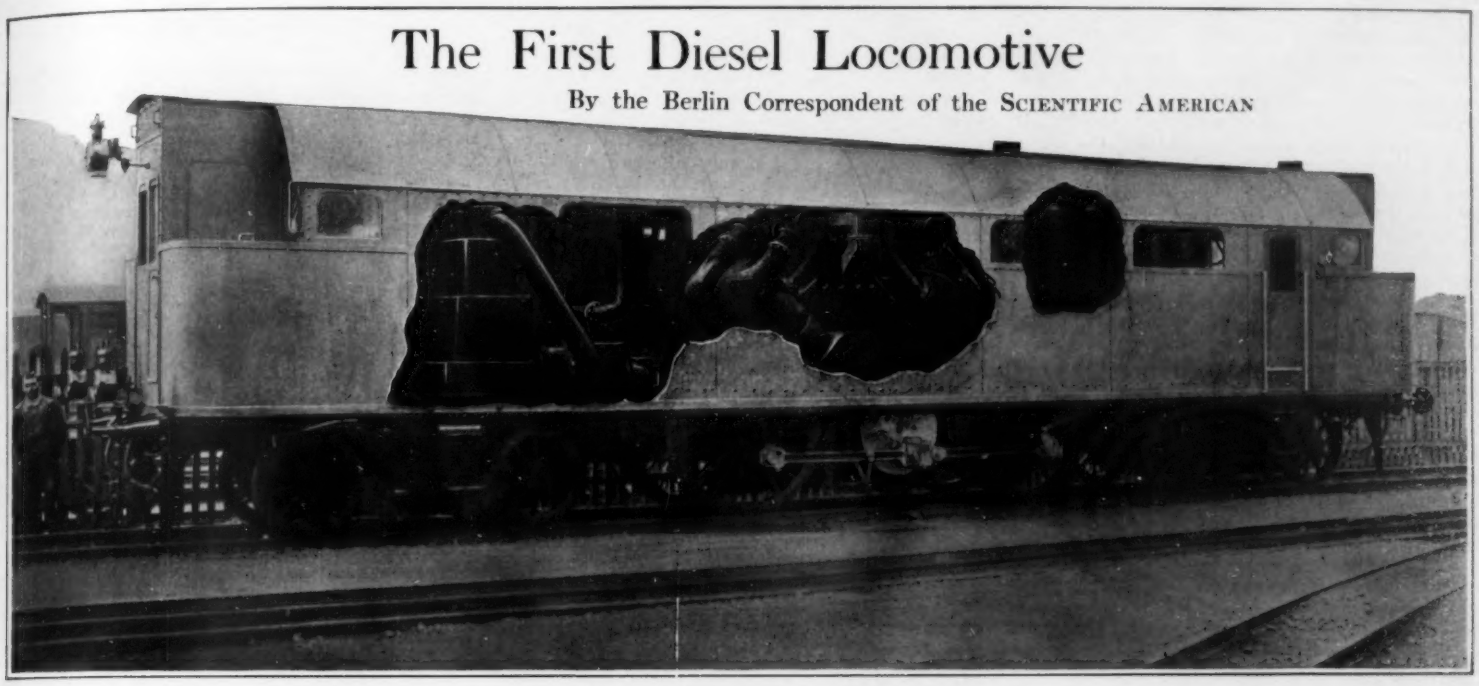
THERE is no more remarkable plant, if regarded from an economic point of view, than *Erythroxylon coca*, although as a plant it is not well known in the botanical world. From its leaves is obtained a narcotic which is considered a stimulant and tonic and is used extensively in Peru, Ecuador, Chili, Bolivia, and other parts of South America. It is used both as a remedy for various diseases, and also as a nervous stimulant and restorative. It is said that by chewing a sufficient quantity of coca leaves, a man is capable of dispensing with food for five days without any material inconvenience, even though he is engaged in hard physical labor.

Coca leaves, which are small in their fresh state, and light green, are produced by a small shrub about 4 feet high. The flower is white and the fruit a small red berry. The plant is propagated by seed in beds and later transplanted in the open at the beginning of the rainy season. Coca is grown on a commercial scale, chiefly in Peru, where a crop of leaves can be obtained every four months, eighteen months after planting, and for many years, if the plants are not destroyed by the ants, which are so destructive in the tropics. As soon as the leaves are gathered they are thoroughly dried to avoid any moisture or dampness after storing them.

Erythroxylon coca is a plant which grows in moist and woody regions chiefly on eastern slopes of the Andes. Much attention has been bestowed upon its culture, which has increased the supply to such a degree that during recent years many hundreds of thousands of dollars worth are exported from Peru alone. The United States uses large quantities of these leaves annually. The average value of this product used in this country amounts to about $135,000. At the present time Peru furnishes the bulk of the coca leaves used outside of that country. The plant has been introduced into India, Ceylon, Java, and other parts of the East Indies.

The First Diesel Locomotive

By the Berlin Correspondent of the SCIENTIFIC AMERICAN



THERE can be no doubt but the increasing adoption of electric traction, though ousting the steam locomotive from its unrivaled monopoly, is indirectly responsible for a number of improvements lately adopted in its design. However, a common competitor is now arising in railway traction to both types of prime mover, viz., the Diesel or high-compression oil engine, which after its recent achievement in ship propulsion, enters at length this field so far closed to its activities. It is significant of the high development reached by the oil engine that the first Diesel-motor operated locomotive should be, not some modest engine designed to haul a suburban or slow train, but an express locomotive destined for service on the Berlin-Magdeburg trunk line. This Diesel locomotive, the construction and trials of which have been watched with unusual interest in German engineering circles as well as abroad, was supplied to the Prussian Hessian State Railways by the Gesellschaft für Thermo-Lokomotiven, founded by Messrs. Gebrüder Sulzer of Winterthur, Switzerland, Government Engineer A. Klose of Berlin (who is responsible for the design of the mechanical part of the locomotive) and Dr. Rud. Diesel of Munich. It has been constructed at the workshops of Messrs. Gebr. Sulzer, who designed the engines.

The motive part of the locomotive mainly consists of a driving engine direct-coupled to the driving axles and an auxiliary engine working quite independently of the driving axles. This has an output about 1/5 to 1/4 that of the main engine and serves to generate compressed air, for operating the main engine in starting, on heavy gradients, etc., with high charges. Moreover, in order to increase temporarily the output of the auxiliary engine, there have been inserted between it and the driving engine, air tanks from which a certain amount of air can be derived during standstills of the auxiliary motor or even while this is working.

In Fig. 3 is shown Messrs. Sulzer's patented arrangement of the driving and auxiliary engines. *a* is the driving engine coupled to the driving axles *b*, the engine to meet the special requirements of locomotive operation, being reversible; *c* is the auxiliary engine which serves to drive the compressor *d*, supplying compressed air through the conduit *e* to the driving engine *a*, there to be used as starting or fuel injection air.

In starting, the auxiliary engine *c* is kept working, thus throwing a continuous supply of compressed air into the main engine. The latter can thus be given a considerable inflow, which may be even increased by supplementary air from the tanks *g*. Compressed-air operation alone allows the train to be accelerated up to 8 to 10 kilometers per hour, after which fuel operation is proceeded with, the engine now working on the normal constant pressure (Diesel cycle). There is

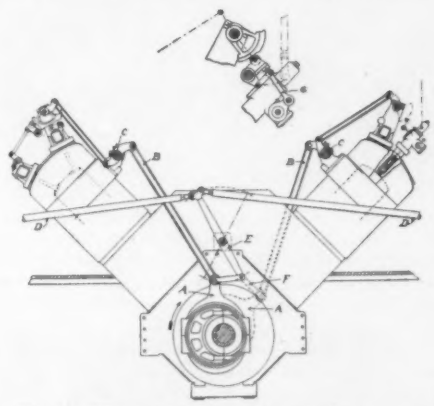


Fig. 1.—The eccentrics and reversing gear.

however another means of air-supply available. Instead of deriving the whole of the compressed air from the pumps coupled to the auxiliary engine, part of the air required can be supplied by means of the auxiliary

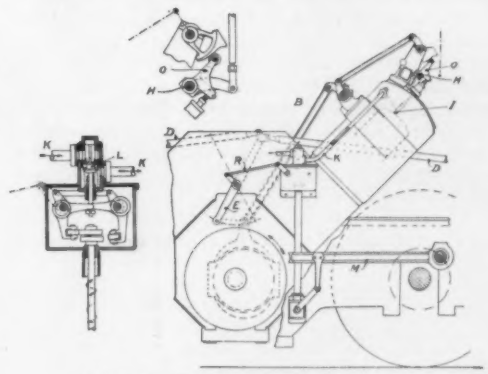


Fig. 2.—Starting valve and gear.

engine and part by the driving engine, these being likewise made to operate pumps.

The above is the general arrangement of the Diesel locomotive. In the following are discussed the mode of working, details of design and the results of some tests.

The express train locomotive herewith represented is 16.6 meters in length between buffers, and 95 tons in weight in full working order. The coupled wheels are 1.75 meters in tread circle diameter. The driving energy is transmitted from a loose shaft to the coupled wheels by coupling rods designed in the usual manner. The heads of the rods are fitted with adjustable journal brasses.

The main frame is of the box pattern. It carries in its central part the support and driving bearings of the driving engine; this support consists of a steel casting and serves to carry the loose shaft. The motor cylinders are also held by cast steel cross-ties. At one end there is fitted the base of the auxiliary engine. The frame cross-ties, made up of sheets and angles, carry the bogie pivots and at the same time serve as coupling boxes to receive the draw-bars. The draw and buffer gears are designed in accordance with official regulation by the Prussian Railway Department. The driver's cabin takes up the whole length of the locomotive, thus protecting the driving gear. Tanks are fitted into each of the four corners of the locomotive body, those at one end serving to store cooling water, and those at the other end, cooling water and fuel. In the roof, above the driving engine, there is situated the exhaust tank; above one of the driver's stands a honeycomb radiator, and above the other, the evaporation cooler. Two pumps, driven by the main and auxiliary engines, respectively, ensure the circulation of cooling water, the drawing off of piston cooling water and the raising of fuel from the tank.

The driving engine is a reversible four-cylinder single-acting Sulzer motor, designed on the two-cycle principle. The four working cylinders are set by pairs at an angle of 90 degrees to one another, and all of them at 45 degrees to the plane of the track (in V-fashion), and are of 380 millimeters bore and 550 millimeters stroke. Each pair of working cylinders is situated in the same plane and made to act on a common crank pin, the rods being forked so as to insure perfectly symmetrical effects. The two cranks are set at 180 degrees and are designed to run at 304 revolutions per minute at a traveling speed of 100 kilometers per hour. The crank shaft carries in addition to the two working cranks at the outside two pressed-on crank disks with balance masses, transmitting their rotation through coupling rods to the driving axles of the vehicle. By this patented arrangement a perfect bal-

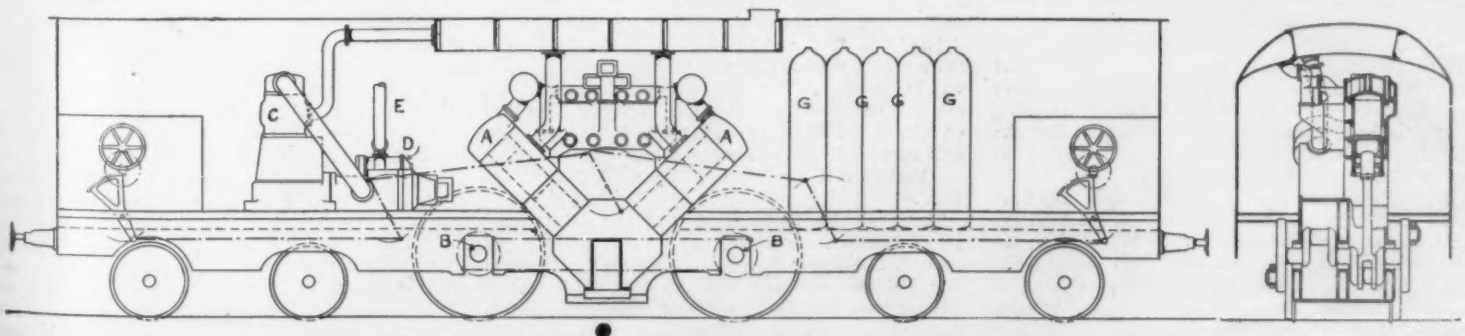


Fig. 3.—Sections showing general arrangement of engines and accessories.

ance is insured between the primary forces of the reciprocating masses of the working cylinders and the centrifugal forces of the cranks, coupling rods and balance masses. Each cylinder carries a fuel valve, a starting valve and two scavenging valves for the injection air (at 50 to 70 atmospheres), starting air (at 50 atmospheres) and scavenging air (1.4 atmosphere + absolute). The exhaust is discharged through slits in the cylinder wall, which are opened and closed again by the piston. Between the crank disks and the frame there are two eccentrics, each controlling all of the valves of one half of the engine and which can be turned round in reversing the motor, when the traveling direction is to be changed. This is done by means of a special rigging *d, a, f* (Figs. 1 and 2). The position drawn in full of the lever *c* corresponds to forward running, the position drawn in dots and dashes to backward running of the motor. The motion of both eccentrics *a* is transmitted by rods *b* to the two lever shafts *c*, which actuate in their turn the valves in the cylinder covers. In the cylinder visible to the right, there is marked the steering of the fuel valve, whereas the steering of the scavenging valve is illustrated in the left cylinder (on the other side of the vehicle). The steering of the fuel valve is so designed as to allow various degrees of admission to be obtained, by altering the position of an intermediary piece *g*. The two fuel pumps, the pistons of which (four in all) are likewise driven from the valve gear, are not shown in the figure. The starting valve is controlled in a similar manner to the fuel valve. Variations in the duration of opening of the starting valve (which are obviously more considerable than the range of variation of the fuel valve) are effected by turning round the shaft *h* on which the intermediary piece *o* connecting the valve gear and starting valve is mounted. In front of the starting-air valve *i* there is inserted into the starting conduit *k* another organ *l*, which is likewise controlled by *r* and actuated from the coupling rod *m*.

The arrangement of two steered organs in the starting-air conduit allows a constant admission of air (previous to the entrance of fuel) to be adjusted for, while reducing losses due to throttling. With a single starting valve it would be difficult to so design the valve gear as to keep this air admission constant with all degrees of admission intermediary, as in the present case between 0 and 68 per cent. Throttling valves, on account of their slow opening and closing, would likewise result in material losses. These drawbacks are obviated by the arrangement above described.

Between the four working cylinders of the driving engine there are placed two double-acting reciprocating pumps, and beside these, a three-stage injection air pump, all three pumps being operated from the two connecting rods of the two front working cylinders, by the intermediary of balance beams and articulated rods, and fitted with safety valves.

The injection air pumps serve as stand-by for the auxiliary engine air pumps. Should the auxiliary engine, for some reason or other, be unfit for working, the injection air pump would be able with normal speed and moderate loads on the driving engine, to supply a sufficient amount of injection air.

The auxiliary engine is likewise a two-cycle Diesel motor, its output being 250 effective horse-power. It comprises two vertical cylinders of 305 millimeters bore and 380 millimeters stroke, and is supplied with fuel by a two-piston fuel pump. The connecting rods of the two multiple-stage horizontal air pumps are arranged to act on the two motor cranks set at 180 degrees.

The driver's cabin contains four hand-operated wing pumps, three of which serve to fill the cold water, fuel and circulation conduits, even in case of standstill of the two engines, whereas the fourth one communicates with the forced lubrication of the driving engine, thus allowing any gearing parts inclosed in the crank casing to be lubricated in case of standstill of the locomotive. The conduits are led to both ends of the locomotive, thus allowing all cooling water compartments and conduits to be readily discharged.

At each end of the locomotive there is a driver's stand comprising the mechanism for reversing the main engine and the following arrangements: Levers for throwing the starting and fuel valves in and out of gear, a lever for controlling the amount of fuel raised by the fuel pumps, the starting head, the braking valve and sander, the signal whistle and various gages.

The following operations are required in getting the locomotive ready for starting, in stopping and in reversing:

Starting.—The starting-air valve at the starting head being slowly opened, air is allowed to flow from the starting tanks to the starting valves of the engine; the air pressure rises slowly and the engine begins rotating. The charge supplied from the starting valves is gradually reduced, while the pressure rises. When a speed of about 10 kilometers per hour has been reached, the starting-air valves are thrown out of gear, and the fuel valves are set working. The locomotive then is in normal working order, the charge of the fuel pump and the pressure of the injection air being controlled in accordance with the speed and output.

Stopping.—Throwing the fuel valves out of gear and actuating the brake valve.

Reversing.—By turning the hand-wheel round in the driver's stand, the valve gear is adjusted to backward running. A blocking arrangement prevents the engine from being reversed, while the fuel valves are thrown into gear. In starting, stopping and traveling, the same operations are performed, when going forward and backward, respectively.

After some preliminary trial runs on the Winterthur-Romanston line, the locomotive was taken under its own power to Berlin, partly hauling on its way a fast freight with its steam locomotive at a speed of 70 kilometers per hour; the traveling speed, in accordance with time-tables, varied between 20 and 180 kilometers.

Commissioner Moore's Last Report

IN his report of August 14th, 1913, to Congress for the year ended December 31st, 1912, Mr. Moore, the retiring Commissioner, shows the receipts of the Office from all sources to have been $2,118,158.30, and the expenditures $2,022,066.11, leaving a surplus of $96,092.19 and the amount of the total net surplus, being earnings of the Patent Office, deposited in the Treasury of the United States, to be $7,160,017.95.

In proportion to population more patents were issued to citizens of Connecticut than to those of any other State—one to every 1,150. Next in order are the following: District of Columbia, one to every 1,229; California, one to every 1,434; New Jersey, one to every 1,508; Massachusetts, one to every 1,509; Illinois, one to every 1,639; Colorado, one to every 1,711; New York, one to every 1,786, while South Carolina is last in the list of States with one patent issued during the year to every 18,040.

The report includes some statistical tables covering a comparison of the business of the Patent Office from 1837 to 1912; the first patent and the number of patents issued in each year; the number of patents issued by the United States and foreign countries from the earliest period to December 31st, 1912, and an interesting comparison between the receipts, expenditures and volume of business done in the years ended December 31st, 1899, and December 31st, 1912, which shows the percentage of increase is greatest in every item except the number of employees, indicating an increase in receipts and in mass of work without a proportionate increase, but rather with a proportionate decrease in the number of employees of the Office.

Loss of the Zeppelin "L-1"

WHILE flying over the North Sea toward the island of Heligoland, during the maneuvers of the German high sea fleet, the airship Zeppelin "L-1" was struck on September 9th by a violent gale and hurled into the water, carrying with it the twenty-two officers and men, of whom only seven were saved.

This is by far the most disastrous calamity that has overtaken any country in the development of its dirigibles, and no less than consternation reigns in German aeronautic circles. Among those who lost their lives were Capt. Metzing, commander of the marine airship division; Capt. Hanne, commander of the wrecked Zeppelin "L-1," and Baron von Maltzahn. It was also reported that the naval commission appointed to supervise the trials was on board.

The storm which struck the ill-fated airship came up so suddenly that there was no time to make a landing. As the officers and crew were bravely maneuvering to bring the big envelope into the wind a heavy gust suddenly struck her amidships and hurled her into the sea, where, after an hour, she succumbed to the pounding of the waves and sank with fifteen of her officers and crew. When the storm first struck the ship a wireless was sent out to water craft lying in the vicinity of Heligoland. Torpedo boats were immediately hurried to the spot, but succeeded in rescuing only seven of the crew.

The Zeppelin "L-1" was a naval dirigible, the pride of the German navy, and was completed only last year, making her first ascent from Friedrichshafen on October 7th, 1912, and leaving there on a long reliability trial a week later. On this trip Count Zeppelin was in command. The ship carried twenty other officers and members of the crew besides nearly three tons of fuel. She flew to Johannisthal in thirty-two hours and successfully established wireless telegraph communications with a number of German stations on the way.

The ship had a displacement of 22 tons and a capacity of 776,000 cubic feet of gas with 18 separate gas chambers. She was 565 feet long and 50 feet in diameter and was equipped with three Maybach motors totaling more than 500 horse-power, one of these motors being placed in the forward car and two in the rear. The motors drove aluminium propellers, those in front having two blades each, and those in the rear, four blades each. The huge airship was capable of a speed of 52 miles per hour.

For elevation the ship had eight horizontal planes, and for side steering, six vertical planes. The "L-1" model differed from former models in that provision was made for carrying a machine gun on an observation platform above the balloon instead of in the cabin underneath.

Although no less than a half dozen of the Zeppelins have come to grief either through storm or fire, the accident to the "L-1" was the first in which a loss of life had occurred and, strange to relate, it resulted in the greatest loss of life in the history of aeronautics. Before this disaster the greatest loss of life due to an airship accident was five, the result of the wrecking of Melvin Vaniman's dirigible, the "Akron," near Atlantic City, July 2nd, 1912. The "Akron" was constructed for the purpose of attempting a transatlantic flight and was wrecked during one of the trials. A similar accident occurred when the French military dirigible "Republique" exploded, on September 25th, 1909, at a height of 600 feet, killing four French officers.

Before the accident to the "L-1" the latest Zeppelin to meet destruction was the military dirigible "L.Z.-15," which was pounded to pieces by the wind after having weathered the storm for nineteen hours. A brief account of this accident was given in the SCIENTIFIC AMERICAN of April 5th last.

Automatic Train Control

THE recent disaster on the New York, New Haven and Hartford Railroad will doubtless bring out the usual demands for the installation of automatic stop devices, rendering it impossible for the engineer of a train to run past a signal which has been set against him and into a block in which another train is standing. These demands will undoubtedly be met by the statement that no wholly satisfactory apparatus has yet been produced, and the usual controversy may be expected.

Be this as it may, the situation serves only to emphasize the fact that the installation of electric traction upon main-line railways provides a method of controlling train movements wholly apart from the operations of individual engineers, and renders it possible to combine the action of danger signals with the electrical machinery in such a manner that the mere act of setting a signal against a train will also cut off the supply of current, and render any further progress impossible until the opening of the block also restores the motive power.

Even if there were no other advantages found in the use of electric traction, it would seem as if this opportunity of controlling the movement of trains through the control of the supply of motive energy should be worthy of consideration. The New Haven road is already partially equipped with electric traction, and it is possible that the cost of completing this work, and combining it with some such system of automatic signal control would bear favorable comparison with the cost of permitting the continuation of the existing state of affairs.

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT there appears the first instalment of Sir Oliver Lodge's remarkable address before the British Association.—Charles Dury writes on "Insects That Carry Disease."—The Preparation of an Aviation Map of the World is discussed.—An articulated narrow-gage locomotive built for service in Tasmania is illustrated and described.—M. N. Buckman reports on Progress in Egyptian Exploration.—A very fine Elephant Group, the work of the Sculptor-Naturalist Carl E. Akeley, appears on the front cover, and a short article tells our readers about Akeley's work.—E. N. Da Andrade writes on Lenhard's researches on phosphorescence.—The Practical Operation of Gas Engines With Blast Furnace Gas as Fuel is the subject of an important paper by Charles C. Sampson.

Emigration from the British Isles tends more and more to be to other parts of the empire, rather than to foreign countries. Thus there has been a notable falling-off in emigration to the United States. The last annual report of the Emigrants' Information Office, issued as a parliamentary paper, states that of 28,156 letters received only 1.4 per cent related to the United States. As compared with the previous year, inquiries concerning the United States decreased 14.8 per cent. In connection with the emigration of skilled laborers to Canada, an interesting society has lately been founded with headquarters at Winnipeg, known as the Imperial Home Reunion Association. Its object, which is largely supported by employers of labor, is to enable British mechanics working in Canada to bring their families from the home country. During the two years that this society has been in operation 1,347 family reunions have been effected at a cost of about $175,000.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Reversing the Locomotive

To the Editor of the SCIENTIFIC AMERICAN:

I read with interest the discussion in your valuable paper on the virtue of reversing a locomotive to aid in stopping when the air brakes fail to work.

It looks to me as though the writers have failed to show a very thorough knowledge of the working of a locomotive. If it is true that nine tenths of the locomotive engineers refrain from reversing to bring a train to a stop, I think they had best go to school to some of the old-time engineers, who learned to run an engine before air brakes were known or used.

I have many times seen an engineer in the olden days reverse his engine with success, and if he knows how to handle his engine he can materially lessen his speed; in fact, can stop much faster than he can pick up speed.

With all the learned dissertations which have been so laboriously prepared, they seem to be all the effusions of men who are like an esteemed gentleman of my acquaintance who was foreman of a locomotive shop for a large railway line on which there was a strike of engineers and he undertook to run an engine drawing a mail train. He had difficulty in stopping at a water tank, and to make it easier he uncoupled from his train, and after getting water backed up to get his train, but lost control of his engine, and the result was a wrecked train and several dead and injured mail clerks. When he got home, and was asked how it happened, he answered: "I can build an engine all right, but ——"

Now for the old open secret, if such it may be called. If when the brakes fail to operate, the reverse lever is thrown clear over, with the throttle closed of course, the wheels will continue to revolve in the forward direction, but even then they exert some retarding force; then if a small amount of steam be admitted the retarding force will become greater, yet the wheels will continue to revolve in the forward direction, and so long as they continue to revolve in that direction with the above conditions, they are holding back on the train. Of course, if enough steam is admitted to reverse the motion of the wheels, then practically no force is exerted; but an engineer who knows his business and his engine can gage the steam so that he will get very nearly its ultimate tractive power to hold back on the train. Of course, sanding the track will help also, as it gives greater cohesion and enables him to use even more steam without the wheels slipping or turning backward.

I dislike to take part in a discussion of this nature in any periodical, but when I see such mistaken ideas advanced as was done by your correspondents, and in a paper which I consider an authority on technical matters, I cannot refrain. I am gratified that the Editor in his remarks on this subject on July 5th did not coincide with the correspondents, but feel that my explanation above more clearly explains the value of reversing when the brakes fail to work.

Plano, Ill. C. E. W.

A Railroad Adopts the Automatic Stop.

To the Editor of the SCIENTIFIC AMERICAN:

Had the Jones automatic cab signal and train control system, as installed and operating on the Maryland & Pennsylvania Railroad out of Baltimore, been installed on the New Haven road, the fearful rear-end collision caused by the fog preventing the engineer from seeing the signal, would not have occurred.

The Jones system is an electrical closed-circuit system, operating signals and the application of the air in the engine automatically, and so arranged that a train moves within a zone of protection, both front and rear, against open switches, broken rails, rear-end and head-on collisions. It has been tested through sleet and snow and works more perfectly than the human mind. The track is divided into blocks, and as a train approaches a block which is occupied, or where there is an open switch, the engineer is signalled by a warning bell in his cab. If he does not control his train, and attempts to enter the block, or within a certain distance of the danger point, his brakes are set automatically. When the block is clear he gets a signal to proceed. It also prevents the engineer taking a crossover above a predetermined speed, by giving him an automatic stop if he attempts it; or it can be adjusted so that the engineer will receive a caution signal but not a stop if the train is moving below a predetermined rate of speed. The system satisfactorily meets all the conditions imposed by the Interstate Commerce Commission and the Railway Signal Association, and can be installed in conjunction with the present signal systems at comparatively small cost.

The New Haven road offered a prize of $10,000 for a system that would prevent rear-end collisions, to be tried on their road. If successful, however, they are to be allowed to use it over all their systems for nothing. The Jones Company would not enter into such a one-sided proposition, but submitted a counter-proposition, as follows: The Jones Company to equip a portion of the New Haven road with their system at their own expense, the New Haven road to operate it an agreed length of time under their own management. If satisfactory, the railroad company to pay a predetermined price; if not satisfactory, the installation to be removed without any expense to the New Haven road.

An identical proposition was made to the Maryland & Pennsylvania Railroad running out of Baltimore. After testing it for a period of eight months and having it passed on by some of the best signal engineers in the country, they adopted the system, as per the following letter:

Baltimore, July 9th, 1913.

Mr. Calvin W. Hendrick,
President the Jones Safety Train Control System Co.,
Baltimore, Md.

Dear Sir: We have recently increased our passenger train service between Baltimore and Belair, and after the first of September the freight train service will be increased also, and there will be a considerable movement on the tracks between Baltimore and Belair.

As your automatic cab signal and train stop has met all tests placed on same by us during eight months' operation under regular train service, we have decided to adopt the system on our road. You will therefore proceed under the provisions of the contract we have with you regarding extensions, and extend your system on our road to Towson, Md., including the north switch of siding at Towson. In doing the work, please include the several suggestions made by Mr. Scott in his examination of the system now in use.

Yours truly,
(Signed) W. B. BROOKS, Vice-President.

We are now the only automatic cab signal and train control system on a closed-circuit principle that is in daily operation and has a *bona fide* contract with a railroad. The closed-circuit feature has been one of the most difficult requirements of the Interstate Commerce Commission to meet. This feature gives prompt notice to the engineer should any part of the apparatus become disarranged.

Electricity has become a dependable factor, and the automatic electrical control of train movements is bound to come in the near future, as the present control of the trains is costing too great a sum in lives and property. Such appalling accidents as have been happening in the past two years, together with the one that has just happened, are causing a profound impression in Washington that something is radically wrong, and automatic stops to check the engineer have got to come.

As the roads have been claiming that there is no such automatic train stop in existence, I thought this an opportune time to let you know the above facts.

CALVIN W. HENDRICK, President.

Baltimore, Md.

[It is not the practise of the SCIENTIFIC AMERICAN to publish letters of this character; but we feel that the facts given above, showing that a railroad, after making a lengthy test, has found an automatic stop that is so satisfactory as to warrant its installation, under contract, are so timely and significant, that we publish this letter in full.—EDITOR.]

Rewarding the Inventor

To the Editor of the SCIENTIFIC AMERICAN:

It is generally conceded, I believe, that the inventor has done more to assure the mechanical supremacy of America than any other, although it is likewise popularly believed that he rarely gets the reward which should be his.

That he is a prolific species is shown by the eight hundred odd patents which are issued each week by the United States Patent Office. Not that there are eight hundred money-making inventions patented in America every week. The inventor sees merit in the baby of his brain whether practical or not. He has got to be an optimist. A pessimist never would invent anything, because he would start with the idea that the thing could not be done anyhow.

The inventor in his enthusiasm and the newness of his idea can see it only in a favorable light. Cold facts do not disturb him. So he goes blithely ahead and is not at all surprised when he succeeds, though everyone else is.

And this is as it should be; for cold facts ought not unduly to discourage the inventor, nor should ridicule justify him in the abandonment of a revolutionary idea. That a thing has been done differently heretofore, is no reason why a new principle may not be a better one. The expert is more likely to be wrong than right when it comes to a new phenomenon.

This leads one naturally to the discovery of a peculiar condition, that is, that persons or firms who should do so, rarely buy really big inventions. They go plodding along selling the old device until one day they are shocked to find that the public has forgotten the old love and taken up the new. In the light of past experience, it would seem that they should look carefully into any new and startling invention, if for no other reason than as a means of self-defense.

It is historical that the telephone was first offered to the telegraph people, who refused to see any merit in the "toy." It is also historical that the telegraph was later bought up by the telephone company. The disk talking machine was brought to the attention of a musical instrument company, who in rejecting it said that they were already marketing an instrument which had real merit as a means of entertainment. The musical instrument referred to has dropped out of sight, while the disk talking machine speaks for itself in millions of homes to-day.

But there are inventions and inventions; some are improvements of existing devices, meritorious because they enable one to do a thing easier, or in a more simple manner perhaps. Of this kind, the great bulk of inventions are made up. There are other inventions which are revolutionary, which upset the established method of doing things, or which attain a new object heretofore unattainable.

And just here may I cite as a curious fact, that of the revolutionary kind, there have been born in the ten-mile square of the District of Columbia, more startling inventions than in any other equal territory in the world. To believe it one has but to think of the telegraph, the telephone, the electric railway, the electric light, both the talking machines, the motion picture machine as used to-day, both the type-casting machines, etc., the historical accuracy of which is so strikingly attested by the exhibits in the National Museum. To be sure, newspaper publicity has in some instances placed the invention elsewhere, but this does not disturb the facts in the case, but only points to the carelessness with which loose statements are sometimes accredited the weight of facts.

Pure invention and scientific investigation so blend into each other that the line of separation is not a marked one. The mind which conceives the one, is the mind which most easily attains in the other field. Both men are plodders, and take satisfaction more in the attainment of the end, the addition they contribute to the sum total of human knowledge, than in the financial reward. And perhaps this is the real basis for the popular belief that the inventor rarely reaps adequate reward for what he contributes to the comforts and convenience of his fellow men.

The inventor, the scientist, and the artist, are each popularly pictured as a personality obsessed by a single idea, and incidentally that single idea is not financial reward. He has a satisfying ideal, the pursuit of which, however, not only keeps him a poor man, but often works a hardship on those near and dear to him. And that is the real pity of it. The necessity, therefore, of turning aside to some more or less remunerative employment pushes his ideal more and more into the background, until finally distressing circumstances have crowded it entirely out of his reach.

This situation, namely, the necessity of earning daily bread for himself and his, has wrecked more worthy inventions, with the attendant loss of the development funds, than any other single cause. If, however, the financial backers of the invention had the farsightedness to finance the inventor's family, more inventions would reach their fruition, especially revolutionary ones, the results of long-drawn-out study and experiment.

I know that this statement will be seized upon by alleged inventors as a means to the end of living off their fellows. But in what very few instances this may be so, perhaps it is only turning the tables, for, on the other hand, the inventor is notoriously the victim of the man who furnishes him money.

The real inventor, he of the scientific idea, is almost always a worthy man. He follows a high ideal and cannot very well be wholly bad. Being honest himself he believes others honest, and becomes, therefore, the easy victim of the unprincipled promoter, and this is unfortunate.

So in conclusion, if this preachment should strengthen the determination of some discouraged inventor, or aid in securing honest financial backing for his application, and the development of his great idea, it will be a further refutation of the belief that he is the legitimate prey of the heartless "moneyed man" and the equally unscrupulous lawyer. C. FRANCIS JENKINS.

Washington, D. C.

Sawing a Bridge With a Wire

An Old Idea Revived and Improved

By Jacques Boyer

How the old Pont Neuf was sawn apart.

THE Pont Neuf, or "New Bridge," in Paris is more than three hundred years old. Its first stone was laid by King Henri III. in 1578, and it was formally opened by his successor, Henri IV. in 1603, a quarter century later. For three centuries the sturdy old bridge has defied the assaults of time, weather and civil war, and has needed extensive repairs only once—in 1886, when the piles which support one end of it were strengthened. During the Empire the floor of the bridge, which originally was much higher in the middle than at the ends, was lowered and leveled. This alteration strengthened the bridge by diminishing the load borne by the arches and piers.

Now the old bridge has been subjected to a remarkable engineering operation for the purpose of forming, in its solid mass and throughout its entire length, a conduit for electric cables connecting certain tramway lines on one side of the Seine with a powerhouse recently erected on the other side. For this purpose it was necessary to cut a trench more than 4 feet wide and nearly 7½ feet deep, leaving a thickness of only 20 inches over the tops of the arches. In the shorter arm of the bridge the work presented no difficulty, as the mass consisted of rubble, which yielded readily to the pick and the pneumatic hammer. In the longer arm, extending for a length of 550 feet from the statue of Henri IV. to the right bank of the Seine, a solid mass of ashlar, cemented together with concrete containing flint pebbles was encountered. As this mass could not be attacked with explosives or with wedges without endangering the stability of the bridge, the contractor decided to saw it longitudinally with a helicordial wire.

Before entering into the details of the operations required for the solution of this peculiar problem it should be observed that the idea of sawing stone with an endless wire and a pulverized abrasive is more than fifty years old. Various applications of this process are mentioned in a patent granted to Eugène Chevalier in 1854.

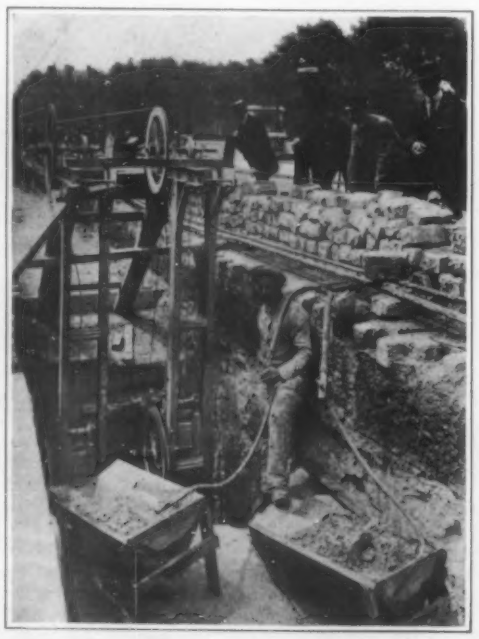
Chevalier claims "the employment, as a sawing tool, of one or more metal wires, cords or chains, acting with a continuous or alternating rotary motion, and sufficiently flexible to attack all sides of the block of stone simultaneously." This interesting process, however, was forgotten until 1880, when it was revived by M. Paulin Gay, with the aid of a Belgian contractor, M. Michel Thomar. Four years later, Thomar improved the process by introducing ball-bearing wheels, by which the cable can be guided in any direction, and boring tools of great diameter for the sinking of shafts for the purpose of separating the sawn blocks in the quarry.

The process still presented a serious practical inconvenience—the difficulty of repairing the wire or cable in case of rupture. Joints made by soldering or brazing in the most careful manner frequently gave way. At last a workman conceived the idea of untwisting the ends of the broken cable, cutting the strands to different lengths and uniting them by a splice four yards long. This device proved successful, and the employment of the helicoidal wire became general in marble and granite quarries, as this method of separating the blocks combines rapidity with economy, avoids the employment of explosives, and, above all, dispenses with the long and costly operation of cutting trenches through the rock. The recent operation on the Pont Neuf, however, is the only instance known to the writer of the employment of the helicoidal wire for sawing a bridge.

The work on the Pont Neuf was divided into three section, of which two were 164 feet long and the third was 223 feet long. Four parallel cuts, from 7½ to 8 feet deep, were made in each section by two sets of apparatus working simultaneously. The longitudinal profile of the work was carefully regulated in order to avoid cutting the extrados of the supporting arches.

In front of the statue of Henri IV. was erected a wooden scaffolding 10 feet high and 26 feet long, which supported a number of wheeled flat cars to which the sawing cables were attached. Each car carried an 18 horse-power electric motor, a speed reducing shaft and the shaft of the wheel which moved the cable. Constant and uniform tension of the cable was assured by cast iron weights suspended from an auxiliary cable attached to the car.

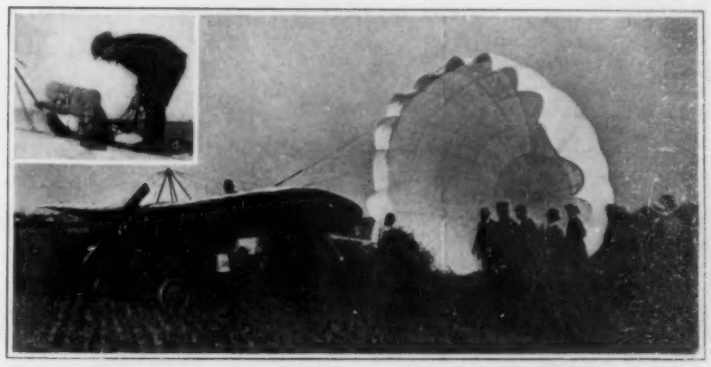
Between the sections wells were sunk to the depth of the cutting to be made. In each well were mounted two iron posts which carried at their tops guide wheels for the sawing wires. From these wheels the wires ran down to other guide wheels mounted on carriers which descended into the well as the work progressed, and which could be raised by means of hand-winches. The wire made a complete circuit from the operating platform to the right bank of the Seine, and back. The work was performed in less than one month by M. Fromholt.



One of the wells sunk in the bridge, showing the method of carrying the grit to the saw cut by a stream of water.

View of the work near the left bank of the Seine, showing the condition of the trench for laying the conduit for electric cables.

The folding sheath in which the parachute is inclosed.



Pegoud demonstrating how the parachute opens clear of the machine.

Recent Aviation Events

Parachute Leap from an Aeroplane

THAT the parachute may become a factor as a life-saving device for aviators was demonstrated at Châteaufort recently, by the noted French airman, M. Pegoud, who has startled his spectators a number of times by his feats of daring while in the air. Pegoud's experiment consisted of leaping from his monoplane and descending slowly and safely to the ground by means of a specially constructed parachute, the invention of M. Bonnet.

The experiment was considered extremely hazardous, and it is stated that Pegoud had a long altercation with the police authorities before he was allowed to attempt the demonstration. The accompanying reproduced photographs show the method of attaching the parachute to the aeroplane. The parachute is contained in a folding sheath attached to the upper part of the fuselage, and the ropes are fixed around the aviator's body. In case of an accident or when the pilot is ready to abandon the machine, he presses a lever which causes the sheath containing the parachute to open, thus allowing the wind to catch the folds of the parachute. As the large umbrella-like structure unfolds and inflates itself it rises and lifts the aviator away from the machine with it, thus leaving the plane to its fate, while the pilot descends safely.

On the day of the experiment Pegoud ascended in a strong wind to a height of about 900 feet and pressed the lever which released the parachute. The machine began to descend swiftly and the spectators were filled with apprehension; but almost immediately the outline of the parachute revealed itself and the aviator was lifted clear of the machine, dropping slowly and safely to the ground. The aeroplane, left without a pilot, was, of course, completely wrecked when it struck the earth.

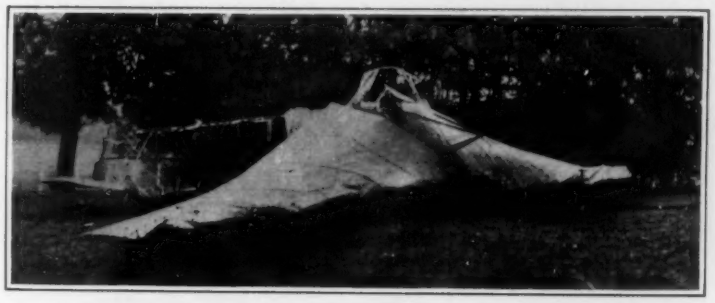
Pegoud is the aviator who is reported as having recently accomplished the daring feat of flying an aeroplane upside down and again righting the machine and descending safely without damage to the aeroplane or to himself. The machine which Pegoud uses in all of his flights is a Blériot monoplane, fitted with a 50 horse-power Gnome motor.

A New French Water Glider.

A hydroplane of novel construction has recently been seen maneuvering on the Seine near Paris, driven by M. Tellier, who designed and built the machine. Tellier is a French aeroplane enthusiast who has been engrossed for some time in the study of air-propelled water machines, and has perfected the glider which is illustrated herewith.

This machine has a typical aeroplane fuselage mounted on three boat-like scows, and is steered by means of a hand-wheel connected with the rudder. In front of the driver's seat is an extra seat for a passenger. The hydroplane is driven by a four-cylinder, 50 horse-power Daimler automobile motor, which is connected with the propeller shaft by a chain. The motor is of the water-cooled type, and is supplied with cooling water from two long vertical radiators placed above the motor at the extreme end of the frame. The fuel tank is attached to the frame at the rear of the motor. The propeller is a Levavasseur of the helical blade type.

An important feature of this machine is the very small amount of draft; when in motion the floats draw less than 10 centimeters of water, which contributes to the high speed attainable. It is claimed that the glider is capable of a speed of 70 kilometers, or about 43.5 miles per hour.



Wrecked monoplane, which fell to earth after Pegoud's parachute leap.

Rear view of the showing V-shaped cave under sur-

The tailless machine in flight.

Dunne biplane, wings with con-faces.

New Dunne Aeroplane May Solve Stability Problem.

Much interest has been aroused in the world of aviation over the recent series of successful flights of Lieut. J. W. Dunne and Jules Felix in the new Dunne aeroplane, which seems to prove the contention that stability in air machines has at last been realized. The principles upon which the Dunne machine is constructed are simplicity, stability and safety, and if the designer's predictions are realized it is probable that within three or four years the art of flying will be well on the road to perfection, and that with the adoption of the stable aeroplane, flying will be as safe as automobiling.

Although the principle of the Dunne machine is not entirely new, the V type of wing having been used in gliders as early as 1906, its application to the power plane is an improvement. It was chiefly through his experiments with models that the inventor was lead to design his present machine. The principal feature which first attracts the attention is the V shape of the wings with the point at the forward end of the machine. Since the two wings or planes are complete in themselves, being provided with warping extremities, the front elevator and the tail are eliminated. The V-shaped wing is applicable either to the monoplane or the biplane.

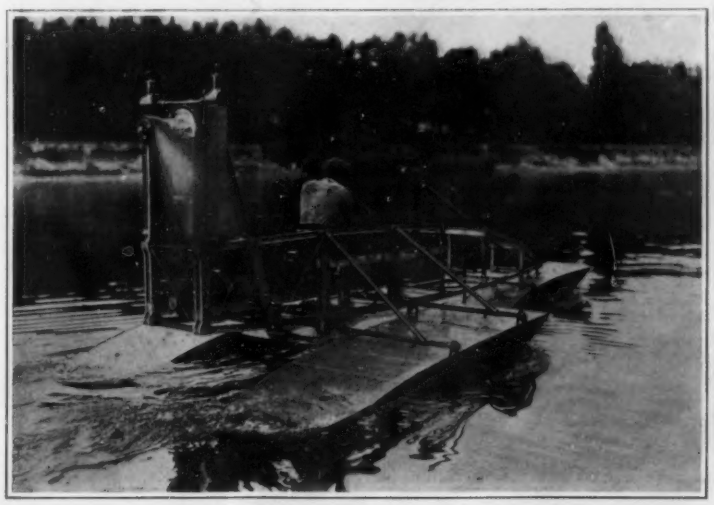
Another feature that is emphasized is the manner in which the front edges of the wings are turned down so that the plane sections present nearly a cylindrical curve. In a communication to the Aeronautical Society of Great Britain, read at one of the society's meetings, Lieut. Dunne described his machine, referring particularly to the construction of the wings, as follows:

"I give the wings a much more definite arrow form than that of the Zanonia (leaf) type; the tips are rolled down in front instead of rolled up behind, so that we have a concave under surface instead of a concave upper surface in this region; while the outstanding feature of the type is the fact that the whole wing forms the roof-part of a tunnel running backward and outward across the wing, the crown of the tunnel being sloped back at a greater angle than are the wings themselves, and the sides of the tunnel preferably converging toward the rear end. The improvement in efficiency gained by this method of construction is very extraordinary; but as I wish to confine myself to the safety devices embodied in the wings, I must ask you to take my word for it that this converging tunnel tends to produce a positive pressure under the negative wing-tip, so that for the same amount of negative *pressure* on the tip we are able to use a greater negative *angle* than in the Zanonia type. And it is the geometrical difference between the angle at the tip and the angle at the front of the machine which counts for most, though not for all, in natural stability.

"My attention having been accidentally directed to fluid flow in diverging, converging, and vena-contracta pipes, it occurred to me that wings built in such forms would give pressure distributions quite different from the ordinary, and also quite different travels of the center of pressure, and were therefore worthy of investigation. But the stability actually obtained with the first model came as an astounding surprise.

"A constant-angle-of-incidence-machine such as this is, *ipso facto*, a constant speed machine. For if the speed is accidentally reduced, the machine begins to sink: this increases the angle of incidence; the re-

(*Concluded on page 233.*)



The Tellier hydroplane on the Seine.

How Deadly is Railway Travel?

STATISTICS have an irritating way of disappointing popular beliefs. That the mortality of railway travel in the United States is too high cannot be open to discussion. It will be too high so long as it remains above zero. But the statistics of the subject disprove such common notions as that it is rising, that it is not falling or that it compares terribly with the average mortality of railway travel elsewhere in the world.

If you take the number of passengers carried and divide it by the number of killed during a year, in this country and in Europe, you will get a comparison which is very damaging to the American railroad. It will show that in this country one passenger in every four million carried is killed, against one in ten or twelve million in Europe. But that is not a fair comparison. The average distance each passenger is carried is approximately three times greater in this country than in Europe. It is plain that the risk of travel is in proportion to the distance traveled. The risk of traveling a thousand miles is a thousand times greater than the risk of traveling one mile. Therefore, the only fair basis of comparison is that of "passenger miles." The "passenger mile" is a term used to express a unit of passenger transportation. It is one passenger carried one mile. For illustration, the number of passengers carried by American railroads in 1912 was roughly one billion; but the "passenger miles" were thirty-three billions, because the average distance traveled by each passenger was thirty-three miles. One passenger traveling thirty-three billion miles or thirty-three billion passengers traveling one mile each would make the same number of "passenger miles" as one billion passengers traveling an average of thirty-three miles each.

On the Fair Basis.

On the basis of "passenger miles," a comparison of the mortality of travel in the United States and in Europe is much more favorable to the American railroads. It shows that the number of passengers killed per billion of "passenger miles" was 7½ in Europe and 8 in the United States, during the years of the latest completed statistics, as follows:

	Passenger miles.	Passengers killed.	Killings per. billion pas. miles.
Europe, 1910....	73,555,578,571	554	7.53
U. S., 1912.....	33,510,673,000	270	8.06

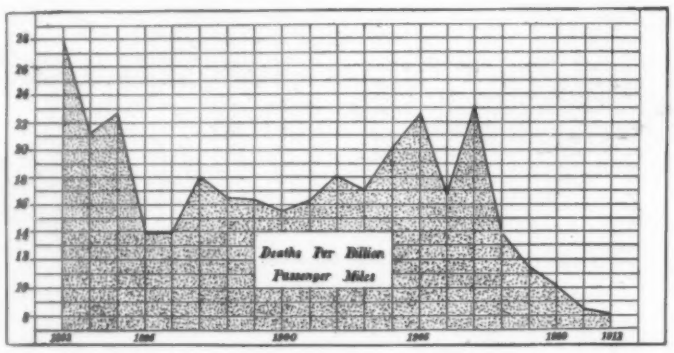
These statistics refer only to passengers. The mortality among employees is another matter, in which difference of temperament between the foreign and American employee is an important factor. Also, as is evident, they refer exclusively to deaths of passengers, and statistics of injuries are purposely omitted, for the reason that they are imperfect. Deaths are a definite quantity and the statistics are continuous, so that comparisons are accurate. That is not true of injuries, which might seem to increase for no other reason than that they are more systematically reported as efforts are made to decrease the risks of travel and railroad employment. Actually the ratio of injuries to deaths should be fairly constant.

The Improvemcnt Here.

More important than that the rate of mortality in American railway travel compares less unfavorably with that in Europe than is generally believed is the fact that it is remarkably falling in this country. The "passenger miles" (the number of passengers carried one mile) reported by all the railways in 1912 were 33,510,673,000, and the number of passengers killed, as reported by the Interstate Commerce Commission, was 318. According to the Bureau of Railway News and Statistics, 48 of the killed classed as passengers were in fact employees, so that the net number of passengers killed in 1912 was 270. That is roughly eight passengers to each billion of "passenger miles." In 1892 the number of passengers killed per billion of "passenger miles" was 28. The fluctuations in the number from 1892 to 1912, inclusive, and the remarkable tendency to decline, are shown in the chart. The figures are shown in the table below.

To show that railway travel is not so deadly as it is thought to be is not to say that it is not much more deadly than it ought to be; but certainly the railroads are entitled to the statistical proof of what they have already done to lower the rate of mortality.

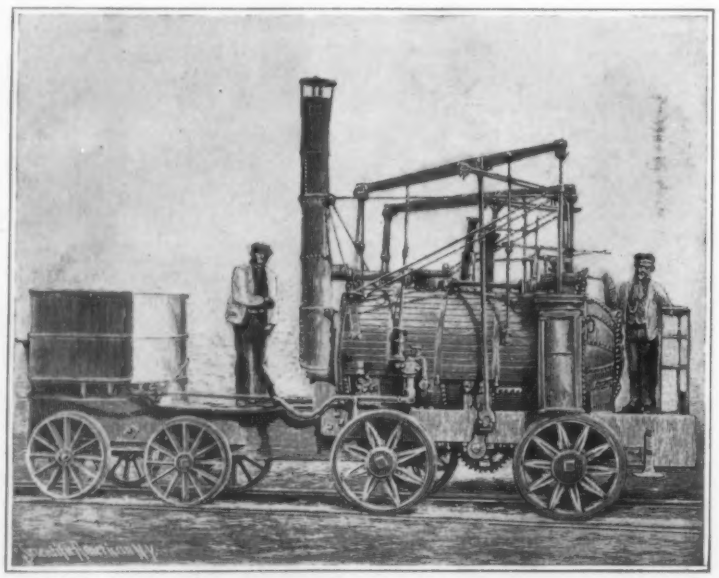
That by the fairest possible statistical comparison the rate of mortality yet is higher in this country than in Europe does not absolutely prove that the railroads are less zealous in this country to protect the lives of passengers. Owing to the differences in equipment it is impossible for the European travelers to take the voluntary risks which American travelers take. Before a European train starts every passenger is tucked away in his compartment. There is no such thing as a tardy one running to overtake his train. It might be argued, too, that the risk of travel increases faster than the distance, but that, of course, is an abstraction.—New York *Times Annalist*.



The falling rate of mortality in railway travel.

Kaiser Wilhelm Canal Locks the Largest.—The recent enlarging and general improvement of the Kaiser Wilhelm ship canal has included a reconstruction of the locks on dimensions which entitle them to be called the largest in the world. They are 147.6 feet wide, 1,082.7 feet long and 45 feet deep. The new locks of the Sault Ste. Marie Canal will be considerably longer, 1,200 feet in length over all, but they will be 80 feet in width only as against the 147.6. The Panama Canal locks are 110 feet wide by 1,000 feet in length, with a depth of water of 40 feet.

Year.	Passenger miles.	Passengers killed.	Killings per billion pas. miles.
1892	13,362,898,299	376	28.00
1893	14,229,101,084	299	21.05
1894	14,289,445,893	324	22.66
1895	12,188,446,271	170	13.93
1896	13,049,007,233	181	13.92
1897	12,256,939,647	222	18.05
1898	13,379,930,004	221	16.50
1899	14,591,327,613	239	16.37
1900	16,038,076,200	249	15.50
1901	17,353,588,444	282	16.21
1902	19,689,937,620	345	18.02
1903	20,915,763,881	355	17.00
1904	21,923,213,536	441	20.13
1905	23,800,149,436	537	22.56
1906	25,167,240,831	418	16.65
1907	27,718,554,030	647	23.35
1908	29,082,836,944	406	13.95
1909	29,452,000,000	335	11.35
1910	32,338,496,329	324	10.03
1911	33,201,694,699	281	8.46
1912	33,510,673,000	270	8.06



Engine "Puffing Billy," Wylam Railway, 1813.

The Centenary of a Famous Locomotive

By Herbert T. Walker

IT may not be generally known that one hundred years ago a practical locomotive engine was built in England, ran successfully for many years, and is still in existence.

This locomotive, named "Puffing Billy," is shown in the accompanying illustration, which was made from an illustration of the engine when it was doing its daily work.

To get at its history we must go back to the year 1812, when Christopher Blackett, a proprietor of the Wylam Colliery, near Newcastle-on-Tyne, who had been searching since 1804 for some means of haulage better than animal power, made some experiments with a frame mounted on four smooth wheels driven by manual power working cranks connected with spur wheels. The object of this experimental carriage was to ascertain if a locomotive engine, having smooth wheels running on smooth rails, could pull anything of a load; for up to that time all locomotives had toothed wheels running on rack rails. It is true that Trevithick's engines had smooth wheels, but they failed for other reasons. The result of these trials, which were carried on under the supervision of William Hedley, Blackett's "coal viewer," were so encouraging that early in the year 1813 the frame and wheels were fitted with a cast iron boiler and a single steam cylinder 6 inches in diameter, which drove the wheels through intermediate gearing. After repeated trials with this experimental engine the construction of a new one was decided upon, chiefly because of the defective steaming capacity of the boiler. No time was lost, and in the same year Blackett ordered Hedley to rebuild the engine with a new boiler and cylinders. This was done with the assistance of Timothy Hackworth, who was foreman smith at Wylam and a clever mechanic. In fact, at that period blacksmiths were the only mechanics who worked in iron and practically all the early locomotives were made by them. Hackworth was Stephenson's great rival, and there is no doubt that the "father of railways" spent his Sundays at Wylam making notes and sketches of "Puffing Billy" and other engines there which were built and partly invented by Hackworth. For this reason Hackworth deserves a more prominent place in locomotive history than has generally been assigned to him.

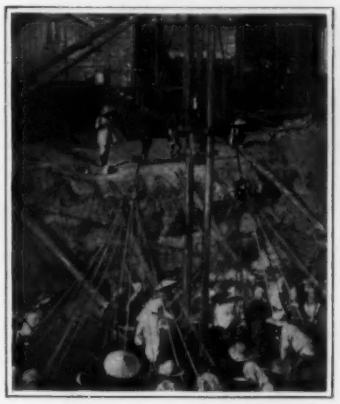
"Puffing Billy" was finished in May, 1813, and put to work hauling coal wagons on the five miles of track connecting Wylam Colliery with the wharves on the Tyne. The engine appears to have been successful from the start, and it attracted much attention, mingled with opposition from those who were interested in horse flesh. It has two vertical steam-jacketed cylinders, 9 inches diameter by 36 inches stroke, which by grasshopper beams transmit the power downward by connecting rods to a shaft with cranks set at right angles. This shaft is journaled in the frames, which are of wood, and carries a spur wheel, which, by four other spur wheels, transmits the power to the four driving wheels, each 39 inches in diameter. Steam was distributed by short D slide valves worked by a tappet motion. The working steam pressure was 50 pounds per square inch. The boiler is of wrought iron lagged with wood. It has a return flue, so that the furnace is at the same end as the chimney, where the fireman attended to his duties, standing in the tender. The engine driver was stationed at the other end of the boiler, where he had the levers and working parts within easy reach. The tender consists of a wooden frame supported on four wheels and carrying a square water tank and coal box. The combined weight of the engine and tender is about ten tons, and its usual performance was to haul fifty long tons at six miles per hour. The exhaust steam from the cylinders was discharged directly into the chimney, and the noise thus caused aroused so much opposition that legal opinion was taken on the subject, but the nuisance was subsequently abated by passing the exhaust steam into an upright tank fixed on the top of the boiler. From this tank the steam escaped into the chimney. This was probably the first "muffler" ever built.

In those days, the rails were "tramplates" of cast iron, which were of only four square inch cross section, and weighed 36 pounds per yard. "Puffing

(Concluded on page 233.)

Building Foundations in Japan

THE two accompanying photographs were sent to us by a Japanese correspondent to show how foundations are laid in treacherous soil in his country without the use of steam pile-drivers. One of the illustrations shows the completed foundation, and the other the primitive form of pile-driver operated by gangs of men. The pile-driver consists of two guide poles supported vertically over the spot where the pile is to be driven. Mounted between the guide poles is the hammer, which consists of a heavy block kept between the guides by means of cross pieces secured to it. At the top of the guide poles are two pulleys over which pass ropes attached to the hammer at one end and each tied at the other end to a dozen hand ropes. These are seized by gangs of men on opposite sides of the guide poles who haul the weight to the top of the pile-driver and then let it drop on the pile below. With several of these primitive pile-drivers the long foundation, only a part of which is shown in the photograph, was sunk.



Primitive Japanese pile-driver.

A hand-driven pile foundation.

House Moved in Sections

AN enterprising house mover in West Somerville, Mass., finding it practically impossible to move a three-story dwelling as it stood, sliced it straight down through the ridge of the gable, and carted it away in two sections. Each section was about forty feet high. The base, however, was thirty feet in length by twenty in width. The result, of course, was that every moment it threatened to topple over. To obviate this, the brick from the chimneys and the stone from the foundations were loaded upon the first floor for ballast.

While the work of slicing was going on, braces, of course, were required to hold the parts firmly in position. When the two parts were reassembled ten miles away from their original site, the workmen put them together so well that, with a new coat of paint over the whole, no one would ever have suspected the remarkable feat that had been achieved.

The house at its old location stood ten feet above the street level. This was the reason that the peculiar method of transporting it had to be resorted to.

Three-story house sliced in two and moved in sections.

Cabbage palm self-grafted into a tropical evergreen.

The Eiffel Time Signals

ONE reason why wireless telegraphy seems uncanny is that we have no visible demonstration of the electrical surgings up and down the antennæ which generate electro-magnetic waves. However, were our eyes constructed to detect the short-wave light beyond the violet portion of the spectrum, we would see the aerials of a high-powered station aglow with a bluish luminescence. This glow, which is invisible to our eyes, is visible to the eye of the camera. The accompanying photograph, taken from the second platform of the Eiffel Tower and looking up toward the top, shows the ultra-violet glow around the antennæ. The photograph was taken when the Eiffel Tower station was sending out time signals. Wireless time signals are also sent out by the station at Nauen near Berlin, and our own Arlington station, and they have proved of great value to navigators, for by them they may correct their chronometers and determine their position at sea with great accuracy.

Announcing the time from the Eiffel Tower. Note the luminescence along the antennæ.

Motor Chair Built by a School Boy

AN automobile invalid's chair, built by a 16-year-old high school boy from discarded dishpans, brass fenders, window sash chains, gas pipe, part of an old bedstead and various other wornout articles, has been attracting the attention of passersby in Pittsburgh of late.

The miniature car was built by Charles Grunder in an amateur machine shop located in his mother's kitchen. A broken-down invalid's chair, a smashed motor cycle and household junk from the attic, were the materials from which he built the chair for his crippled father.

To start with, the boy repaired the framework of the hand-driven chair. A heavier axle was turned upon his lathe. The rear wheels of the hand-driven chair were too light to carry the heavy machinery of the proposed new chair, while the wheels of the smashed motor cycle were too large to fit into the frame of the old chair. This difficulty held up the work for several days. At last the boy rebuilt the motor cycle wheels, cutting them from 30 to 28 inches. Pneumatic motor cycle tires, the only new things about the whole chair, were then purchased. A gasoline tank was made from a discarded dishpan, and incased in a box made from the thin cherry paneling of the headboard of an old bed. Stop cocks from an old gas stove were used to regulate the flow of gasoline. A belt drive being found inadequate, the boy substituted a chain drive. A band brake on the left side of the motor chair, made from the iron hoop of an old washtub, works on a drum cut from a casting. The same lever that throws out the clutch applies the brake. The tire of the front wheel is wrapped with a brass window chain to prevent skidding, the rear wheels being equipped with anti-skid tires. A dog chain was at first used on the front wheel but it was unsatisfactory. The lever controlling the supply of gas feeding into the carbureter is made from an old file. The cut-off valve is made from a one half inch gas pipe "T," a brass curtain rod and a clock spring. The steering lever is made from a length of gas pipe and the end of a mop handle. The 2¾ horse-power motor is air-cooled, the fan being made from an old brass fender, and the blower-case from a tin can which at one time held a gallon of apple butter. The blower-case is covered with asbestos to deaden the sound. The boy constructed the entire oiling system from brass tubing and a little solder. A tiny bicycle lamp to comply with the city ordinance completes the outfit.

Motor invalid-chair built by a school boy.

Copyright P. V. Reyes.

The "sea ghost," a giant species of sea-anemone.

Grafting Performed by Nature

IT is common to see a tree or plant grafted by man into another tree or plant of the same class, but of a different species. But an instance of a tree of one class having been successfully grafted by man into a tree of a wholly different class is certainly most extraordinary. How much more of a curiosity, then, would be the sight of a tree of one class grafted by Nature into a tree of another class. And yet such a feat has been accomplished, as witnessed by the accompanying photograph, which shows a *cabbage palm*—an endogenous tree—*self grafted* into an exogenous tree (a *tropical evergreen*). This photograph was taken in January of this year. The tree may be seen about a mile out of Santa Fé, Isle of Pines, West Indies, on the Government road or calzada leading from Santa Fé to Jucaro. It stands in the front lawn of Mr. L. E. Byers, an American resident of this isle, which is said to be the "Treasure Island" of R. L. Stevenson. The lower portion of the palm is dead, and can be seen in the photograph close to the young lady. The upper portion, however, is in perfect condition, and is as smoothly coalesced with the body of the exogenous tree as are the latter's own branches, and receives its nourishment from its foster parent. Nature did this wonderful piece of grafting by the method called "in-arching," and it probably precedes artificial in-arching.

Remarkable Giant Sea-anemone

THE deep-water reefs off the islands of southern California, particularly Los Angeles County, are very prolific in strange creatures, which are brought up occasionally by fishermen.

One of these odd creatures is shown in the accompanying illustration. It is the giant of the sea-anemones, in a land where these animals are giants in every sense of the word. The anemone is a cousin of the coral polyp; is, in point of fact, a polyp similar to the coral except that it is without the faculty of secreting lime.

The anemone here shown is a dweller in water from eight hundred feet to one

(*Concluded on page 234.*)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

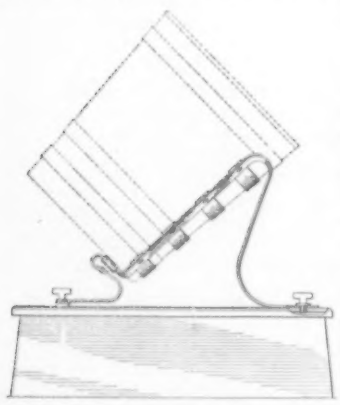
Of General Interest.

GREENHOUSE GLAZING.—F. VAN ASSCHE, Fulton and Rose Aves., Jersey City, N. J. The invention provides a roof formed by panes of glass which is smoothed between the sash bars receiving the glass, and in which the panes of glass can be replaced without disturbance to

IMPROVED SYSTEM OF GREENHOUSE GLAZING.

the panes lying between the same sash bars. A channeled bar is provided between every two consecutive panes of glass lying between the same pair of sash bars. This channel bar is supported by the sash bars and constitutes a bed for putty with which the juxtaposed ends of the panes are sealed.

ATTACHMENT FOR SCALES.—F. D. SHEA, 164 Chambers Street, New York, N. Y. This device is adapted particularly for the weighing of butter. It consists of a resilient support secured to the platform of the scales,



SHOCK ABSORBING ATTACHMENT FOR SCALES.

which will absorb most of the shock when a tub of butter is thrown hastily thereon, thus relieving the scales of jar and making it possible to ascertain the weight of a tub of butter more quickly.

BOTTLE.—H. A. STERN, 565 West 148th St., New York, N. Y. This bottle is of the type adapted to be carried in one's pocket or suitcase, and is provided with a reinforce-

POCKET BOTTLE WITH REINFORCED CASING.

ing casing whereby the bottle proper is better protected not only from the light, but from blows or pressure which would tend to crush or otherwise damage it.

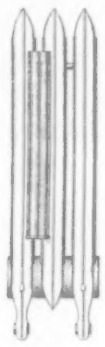
COMBINED WIND AND STRINGED INSTRUMENT.—M. H. MATTES, 733 Lexington Avenue, New York, N. Y. The invention provides a mechanism for vibrating the strings of a piano or like instrument, the object of which is to produce a combined harmonious tone, due to the simultaneous vibration of the strings and the vibrating mechanism.

BUNG-RETAINER AND SEAL.—J. POPPER, 1614 Avenue N, Brooklyn, N. Y. In order to prevent accidental or unauthorized removal of bungs, Mr. Popper has provided a device consisting of a strip which is placed over the bung and secured to the barrel with seals at each end so that if the retaining strip is removed the seals will be broken, betraying the fact.

VENTILATING REGISTER.—F. A. WILSON, 254 Steuben Street, Brooklyn, N. Y. Among the principal objects of the present invention are the following: To provide a register for ventilating purposes with a plurality of louvers, and means for adjusting and holding the louvers in adjusted position; to provide means to limit the full opening of the louvers; and to simplify and economize the construction.

ENVELOP FOR SAMPLES.—L. PLANCHE, 130 Rue du Faubourg St. Denis, Paris, France. The invention relates to wrappers in the form of an envelop and the closure of which is obtained by means of a tongue which is secured on the lower part of the envelop, and which is slid into openings provided on the one hand in the movable flap and on the other hand in the lower part of the envelop.

HUMIDIFIER.—G. A. MAYER, New Dorp, New York. The invention provides a water receptacle which may be attached directly to a radiator. The water in the receptacle being



HUMIDIFIER ATTACHED TO A RADIATOR.

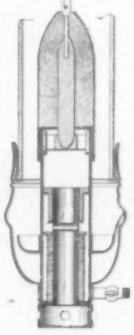
evaporated by the heat of the radiator, will increase the humidity of the atmosphere in the rooms, and thus bring the air to a proper condition for breathing.

Hardware and Tools.

HOSE-CLAMP.—P. E. ERICKSON, Port Chester, New York. An improvement on an invention, previously patented by Mr. Erickson, is here provided. The clamp consists of a band of tough, flexible metal, the ends of which overlap and one of which is formed to receive a clamping screw adapted to bear against a hook formed on the opposite end.

Heating and Lighting.

BURNER.—B. IGLESIAS, Santo Domingo, Dominican Republic. The invention relates particularly to burners adapted to consume alcohol vapor, and is arranged to facilitate the formation and distribution of the vapor. The burner is lighted by igniting alcohol contained in a small annular pan. Centrally disposed within the mantle is a rod which is heated by



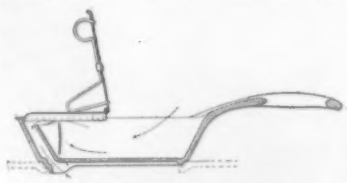
BURNER FOR ALCOHOL VAPOR LAMP.

the burner, and which serves to vaporize the alcohol coming from the main source of supply when that in the pan has been exhausted.

JACKET FOR TANKS.—W. J. KELLS, Jersey City, N. J. This invention provides a temporary cover or jacket for tanks or similar articles, and more particularly for the exposed gas tanks commonly used in connection with automobiles, for supplying the headlights thereof; provides a jacket arranged to be readily and quickly disposed in operative position; and provides a jacket arranged to avoid interference with the tank-anchoring devices with which automobiles are ordinarily supplied.

Household Utilities.

COOKING UTENSIL.—A. E. TRENTOWSKY, St. Johns, New Brunswick, Canada. In order to get rid of kitchen odors, particularly those of frying, stewing, etc., Mr. Trentowsky has invented a pan in which the odors will escape

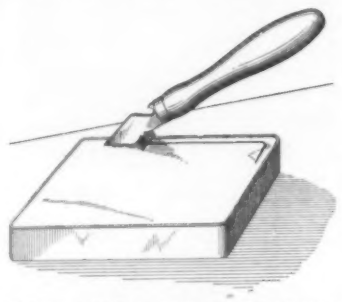


ODERLESS COOKING UTENSIL.

through the bottom of the pan to the interior of the stove and thence to the chimney, provided of course that the pan is set over an opening in the stove top from which the lid has been removed.

COOKING DEVICE.—G. H. CAUGHREAN, Ketchikan, District of Alaska. In order to provide for cooking or heating various articles of food in the cans in which they are packed, Mr. Caughrean has invented a device consisting of a number of steam jackets in which the cans may be placed, and a steel delivery tube with branches leading to each steam jacket.

CAN OPENER.—A. MORELL, 65 S. Pearl St., Denver, Colo. The principal objects of the present invention are to provide a can opener with an improved puncturing point, and an improved fulcrum whereby the liability of

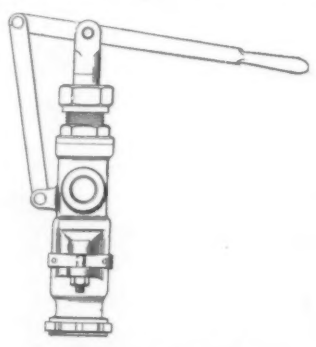


IMPROVED CAN OPENER AND BOTTLE-TOP REMOVER.

injury to the operator is materially lessened. The can opener is also formed at one side with a reset portion which may be used for a bottle cap remover.

Prime Movers and Their Accessories.

BLOW-OFF COCK.—F. H. SMITH, 2505 Gabriel Ave., Parsons, Kansas. The object of the present invention is to provide a construction which will effectually perform the func-



IMPROVED BLOW-OFF COCK.

tions usually incident to blow-off cocks without the necessity of ground joints and other parts which ordinarily require frequent and careful machinery.

Railways and Their Accessories.

RAIL JOINT LOCK.—W. KING and P. L. BETTIS, West Berkeley, Cal. This invention relates to rail locks on splice plates of rail joints, and has reference more particularly to the class comprising a key, and a wedge co-acting with said key and projecting through the splice plates and the web of the rail, and thereby wedging the splice plate against the rail.

Pertaining to Vehicles.

SHOCK ABSORBER.—T. HAND, 5 Pine St., Orlando, Fla. This shock absorber is adapted to take up or resist vibratory movement of relatively movable parts, particularly vehicle bodies and their axles, whereby a violent vibratory movement of the parts is prevented.

VEHICLE WHEEL.—J. L. WOLF, 518 East 119th St., New York, N. Y. This wheel carries an inflatable tube near the hub. The wheel is provided with a center having a protected seat for the inflatable tube. At the periphery of the wheel is a rim supported on spokes carried by a ring that bears against the inflated tube.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & Co.,
Patent Attorneys,
361 Broadway,
New York, N. Y

Branch Office:
625 F Street, N. W.,
Washington, D. C.

PATENT ATTORNEYS

OVER 65 YEARS' EXPERIENCE

PATENTS

TRADE MARKS
DESIGNS
COPYRIGHTS &C.

INVENTORS are invited to communicate with **Munn & Co., 361 Broadway, New York,** or **625 F Street, Washington, D. C.,** in regard to securing valid patent protection for their **Inventions, Trade-Marks** and **Copyrights** registered. **Design Patents** and **Foreign Patents** secured.

A Free Opinion as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our **Hand-Book** on Patents will be sent free on request.

Ours is the **Oldest** agency for securing patents; it was established over sixty-five years ago.

All patents secured through us are described without cost to patentee in the **Scientific American.**

MUNN & CO., 361 Broadway, New York
Branch Office, 625 F St., Washington, D.C.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENTS WANTED

WANTED—One person each locality as agent for complete line Polish Mops, Self-Wringing Mops (5 styles), Fibre Brooms. Line cannot be duplicated. Hilker Mop Co., 1366 Grand Ave., Chicago, U. S. A.

INSTRUCTION

LEARN TO WRITE ADVERTISEMENTS.—Earn $25 to $100 weekly. We can positively show you by mail how to increase your salary. Prospectus free. Page-Davis Co., Dept. 89, Chicago, Ill.

PATENTS FOR SALE

FOR SALE, Patent 1,060,590. Good seller, See-Saw or "Teeter Totter" for children. Small investment required to manufacture. Will sell; worth the money. Other business. Address: W. D., Box 773, New York.

SALESMEN WANTED

SALESMEN MAKING SMALL TOWNS—*Whole Time or Side-Line*, should carry our fast selling pocket side line. Special sales plan allowing return of unsold goods. Makes quick, easy sales. $4.00 commission on each order. *Something entirely new.* Write for outfit today. Canfield Mfg. Co., 208 Sigel Street, Chicago, Ill.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.
MUNN & Co., INC.

Inquiry No. 9311. Wanted names and addresses of manufacturers of hatpin heads made of colored glass; also medals of all shapes.

Inquiry No. 9312. Wanted to buy a machine which will pick up a weight the size of a lima bean by vacuum process. Must be able to pick up dust, gravel, etc. Must be operated by electricity and be easily portable.

Inquiry No. 9313. Wanted to buy Leather Heid Horse Shoes used temporarily when shoe cannot be nailed on. In other words a Leather Boot with iron shoe at bottom—strapped over horse's foot.

Inquiry No. 9314. This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from $5,000 to $10,000. The name of the party will be supplied to any of our readers on application.

Inquiry No. 9315. Wanted the name and address of a concern manufacturing novelty ink wells.

Inquiry No. 9316. Wanted the names of manufacturers and manufacturers' agents who make patented articles and other useful devices which appeal to the public and which can be used in a mail order business and by canvassers.

Inquiry No. 9317. Wanted the names and addresses of manufacturers of good selling articles that would appeal to the public where exclusive sale in certain territories can be arranged for; both to sell to the trade and through sub-agents in a house-to-house canvass.

Inquiry No. 9318. Wanted rollers and other appliances for extracting water and moisture from refuse, such as coir dust, with special reference for using it as a fuel.

Inquiry No. 9319. Wanted the name and address of concerns manufacturing novelties in table or pocket cutlery for the wholesale or mail order trade.

Inquiry No. 9320. Wanted an article suitable for large manufacturing—plant equipped for making Boats, Marine Engines, etc. The plant would be capable of making almost any article. A large wood-working establishment is also operated in connection with the metal shops.

Inquiry No. 9321. Want name and address of a firm who could make a machine for turning out rat buttons. The machine must be capable of making the dough of the exact size required, and also a machine to manufacture the tins and a machine for placing the dough in the tins. Preferably this machine should do all of this work in one operation.

Inquiry No. 9324. Wanted—prices including discounts and full particulars of reliable and inexpensive voiturettes or motor cars for export.

Inquiry No. 9325. Wanted the name and address of some stamping concern in New England who could manufacture a window shade bracket, the materials to be used being 14, 16 and 18/ gauge.

Inquiry No. 9326. Wanted to communicate with those having inventive ability with a view of acquiring or assisting in developing an invention for mail order use.

Inquiry No. 9327. Wanted to get in touch with a patentee of some article requiring a small amount of capital and selling ability.

Inquiry No. 9328. Wanted, names and addresses of manufacturers of curtain poles and curtain pole brackets or extenders; also manufacturers or window shades.

Inquiry No. 9329. Wanted, names and addresses of patentees of useful household utilities preferably for use in the home laundry or kitchen. This inquirer wishes to correspond with a view of purchasing patents outright.

JUNIOR
Keen Kutter Junior Safety Razor No. KJ10. In neat traveling box. Price $1.00
Finely Tempered Blades
Temper is the thing that distinguishes Keen Kutter safety razors and knives—temper that lasts. Of course, the steel is good; that tells in the temper. The design is right; finish is superb. Altogether, these are the qualities that give the highest degree of satisfaction from
KEEN KUTTER
Cutlery
Keen Kutter Regular Safety Razor No. K1 In black morocco case. Price $3.50
The name "Keen Kutter" guarantees the temper—no guesswork about it. Only the finest Swedish steel goes in Keen Kutter Safety Razors. The Keen Kutter Junior at $1.00 is remarkable value. Every knife keeps a keen, true edge.
You'll never have cause to fuss and fret with a Keen Kutter safety razor or pocket knife. But if you do, the dealer will return your money without question. That's the Keen Kutter guarantee.
"The Recollection of Quality Remains Long After the Price is Forgotten."
—E. C. SIMMONS.
Trade Mark Registered.
If not at your dealer's, write us.
SIMMONS HARDWARE CO., Inc.
St. Louis, New York, Philadelphia, Toledo, Minneapolis, Sioux City, Wichita.
KEEN KUTTER
Pocket Knife No. K4322 Price $2.00
Pocket Knife No. K0103 Price $1.75
E.C. SIMMONS KEEN KUTTER
Pocket Knife No. K02161 Price $0.65

Recent Aviation Events

(Concluded from page 229.)

sultant between the lift and the negative pressure, consequently goes back, which makes the machine dive slightly and thus recover its proper speed. While, if the speed is accidentally increased, the machine rises; this reduces the angle of incidence; the resultant consequently goes forward, which makes the machine elevate and slow down to its proper speed."

While Lieut. Dunne was carrying on his experiments in England the British War Office could not be induced to take up the promotion of the machine on account of the skepticism which at that time existed regarding the future of the heavier-than-air machine. Accordingly Lord Tullibardine, chairman of the Blair Atholl Aeroplane Syndicate of London, which was promoting the Dunne machine, was forced to negotiate with a French firm for its manufacture; hence most of the tests have been made in France.

The most recent demonstration of this new aeroplane, a test which seemed to confirm every contention of the inventor, came only recently when Jules Felix, the noted French aviator, piloted the Dunne biplane from Eastchurch across the English channel to the French coast during a storm. Upon landing Felix declared that the machine maintained its stability in the high wind to a remarkable degree, and predicted that this type of machine will eventually become an important factor in practical aeronautics.

The Centenary of a Famous Locomotive

(Concluded from page 230.)

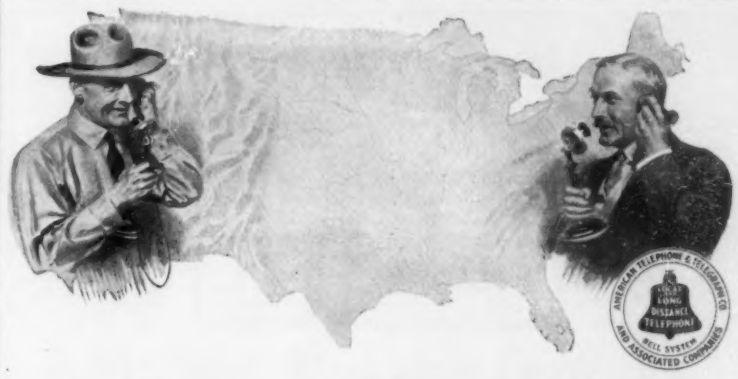
Billy" was thus too heavy for the track, and it was necessary to carry half a dozen spare tram-plates on the engine to replace those which might break during the journey. Therefore, in 1815 Hedley decided to rebuild the engine as an eight wheeler and placed each group of four wheels in a truck frame, thus distributing the weight and enabling the engine to round curves with greater ease.

About 1830 the Wylam road was relaid with cast iron edge rails of the double-flanged fish-bellied type, with half lap joints supported in chairs spiked to cross sleepers. The gage was 5 feet; each rail was four feet long and weighed 39 pounds per yard. The engine was then rebuilt with four wheels and practically restored to its original form, the muffler being removed. It thus worked continuously for about *fifty years*, and it was the first successful locomotive in the world.

A glance at the illustration will show that "Puffing Billy" bears little resemblance to the modern locomotive. The explanation is that the locomotive engine is an offshoot of the stationary engine; for the creations of Newcomen and Watt long ante-dated the designs of Trevithick, Blenkinsopp, Hedley and Stephenson; so that the early locomotives were but little better than stationary engines on wheels—upright cylinders working beams and other gearing being main features in the designs. It was not until 1829 that George Stephenson, after building several unsuccessful locomotives of the "Puffing Billy" class produced his famous "Rocket," which comprised all the elements of the modern locomotive.

In 1865 "Puffing Billy" was placed in the Victoria and Albert Museum, London, where it can now be seen resting upon some of the original fish-bellied rails already described.

To get an idea of the enormous increase in size and weight of locomotives since the days when "Puffing Billy" was at work, we will take the mammoth freight engine in use on the Atchison, Topeka and Santa Fé Railway, which is the largest in existence. This locomotive was described in the SCIENTIFIC AMERICAN of June 17th, 1911, for which reason only a few dimensions need be repeated here for the purpose of comparison: The engine weighs 308 tons, the tender 117 tons, making the total weight 425 tons. Its length over all is 120 feet 7½ inches. The high-pressure cylinders are 28 inches in



The Merger of East and West

"But there is neither East nor West, Border, nor Breed, nor Birth,
When two strong men stand face to face, tho' they come from the ends of the earth!"
—KIPLING.

In the "Ballad of East and West," Kipling tells the story of an Indian border bandit pursued to his hiding place in the hills by an English colonel's son.

These men were of different races and represented widely different ideas of life. But, as they came face to face, each found in the other elements of character which made them friends.

In this country, before the days of the telephone, infrequent and indirect communication tended to keep the people of the various sections separated and apart.

The telephone, by making communication quick and direct, has been a great cementing force. It has broken down the barriers of distance. It has made us a homogeneous people.

The Bell System, with its 7,500,000 telephones connecting the east and the west, the north and the south, makes one great neighborhood of the whole country.

It brings us together 27,000,000 times a day, and thus develops our common interests, facilitates our commercial dealings and promotes the patriotism of the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

2¢ A WEEK
A safe, very brilliant, powerful, steady, white light. Is better than electricity or acetylene and cheaper than kerosene.
Every lamp is a complete self-contained miniature light works.
Clean bright odorless — portable. Made in over 200 styles for every purpose. Fully guaranteed. Catalog free. Agents wanted.
THE BEST LIGHT CO.
817 East 5th Street
Canton, O.
THE "BEST" LIGHT.

Kwicksharp
KNIFE SHARPENER AND SCISSORS GRINDER
AGENTS WANTED
Make Big Money
Sell something everybody needs and will buy. Kwicksharp, in the hands of man, woman or child puts the keenest edge on the dullest cutlery in a moment or two. Small price, big profit. Exclusive territory. No competition. Field for sale—everybody using knives and scissors and wanting to keep them sharp.
Agents MAKE $5 to $10 a DAY
SPENGLER BROS. CO.
Chicago, Ill.

LEARN WATCHMAKING and become independent. Refined, profitable labor. *Good-Paying Positions Secured.* Competent men always in demand. Easy to learn; money earned while studying. Write for our Catalogue. Address, **St. Louis Watchmaking School, Dep't 6, St. Louis, Mo.**

GOLDMAN'S
Arithstyle
Handiest, Fastest, Cheapest, Durable, Reliable
Computing Machine
Adds, subtracts, Multiplies, Divides!
Carries Automatically, Resets Instantaneously
Easily placed on page, held in hand or fixed to Desk.
Labor-Saving, Mind-Resting, Self-Checking!
Special Agents' Offer. Request Instruction Booklet.
ARITHSTYLE CO., Dept. 6 100 E. 28th St. NEW YORK

THE EDISON CONCRETE HOUSE ¶How it is constructed, how much it will cost, is it practical from an architectural and engineering standpoint? These and other important questions relating to the structure are discussed in a good, thorough, illustrated article published in *Scientific American Supplement 1685*. Price 10 cents by mail. Order from your newsdealer or from

MUNN & COMPANY, Inc. *Publishers*
361 Broadway, New York

Dustless, Sanitary Cement Floors

TRUS-CON FLOOR ENAMEL stops dusting of concrete floors. Gives a smooth, tile-like surface. Wear-resisting; stainproof; oilproof. Easily cleaned by mopping. Furnished in a variety of colors. Supplied with a brush.

TRUS-CON FLOOR ENAMEL

is used in Factories, Warehouses, Power Plants, Hospitals, Schools, Offices, Residences, Garages, etc.
FREE—Color Card and valuable suggestions. Write TO-DAY.

THE TRUS-CON LABORATORIES
402 TRUS-CON BUILDING DETROIT, U.S.A.
Waterproofings—Dampproofings, Technical Paints

Does Not Leak

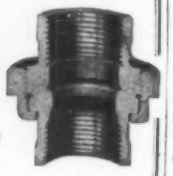
Expands and contracts same as pipe —no expansion leaks.

Cold drawn from rolled steel. There can be no body-leaks due to sand holes or other defects in the metal.

Threads tapered same as pipe and mesh perfectly with the pipe threads —no leaking at threads.

Densified hard steel seat engages a soft brass seat ring—no leaking at seat.

THE MARK
Cold Drawn Steel Union



Won't Rust or "Freeze"

It is Sherardized after threading. The threads as well as the entire body of the union are perfectly protected against rust or corrosion. It won't "freeze" to the pipe. The Mark, therefore, can be removed from the line even after long service without damage to it or to the line. It can be used time and again.

WRITE FOR FREE SAMPLE UNION AND DESCRIPTIVE BOOKLET

MARK MANUFACTURING CO.
1903 Dempster St. Evanston, Ill., U. S. A.

The Chronology of Aviation

THE Scientific American has received from Mr. Hudson Maxim and Mr. William J. Hammer, a limited number of the reprints which they have just issued of the very complete "Chronology of Aviation," originally prepared by these gentlemen for the World Almanac of 1911. The data embrace the essential facts relating to aerial progress. In addition to a short historical *résumé*, one finds herein tables giving altitude records, speed records, quick starting and slow-speed records, passenger carrying, English Channel and other over-water flights, cross-country flights, notable distance and duration flights, etc. There are also statistics relating to accidents and data relative to spherical and dirigible balloons or airships, etc. Of no small interest are the tables giving the most important flights of the Wright brothers. There are doubtless many readers of the Scientific American who are much interested in this subject and who would be glad to secure a copy of this interesting brochure. They can do so by applying to the Aeronautic Editor of the SCIENTIFIC AMERICAN, 361 BROADWAY, NEW YORK

? What is the Aurora Borealis ?

Warren H. Miller, the Naturalist, pries into the mystery of the NORTHERN LIGHTS' gorgeous Arctic displays in POPULAR ELECTRICITY and the WORLD'S ADVANCE for October. You'll enjoy his article and wonder at how little you knew of this fascinating phenomenon. A brisk wisk South to the Blue Ridge Mountains and

A Marvel of the Age

is presented, in the romantic story of an immense district revitalized and made over by a monster modern power development. Another little jump of 9000 miles to examine

The Ancient Tanks of Aden
those world-old Persian reservoirs at the Red Sea fortress, defying time where *it never rains, is hotter than Hades, and mighty unhealthy for a white man.* The

Illuminated Flying Fish
at Catalina Island is a spectacle of the Pacific Submarine Gardens sure to delight and astonish you.

Wireless Between Germany and America
is an accomplished fact, with direct New York-Berlin commercial service an early probability. Big things like this thrill you, so should

Protecting the Lives of 200,000 Steel Workers
an immense "Safety First" campaign to reduce death and danger for "the man on the job". Dr. Robt. Grimshaw in

Heaven-Born and Other Inventors
with delightful humor furnishes food for thought to over-ambitious folk anxious to patent "any old thing". And these are only typical of the

200 Fascinating Subjects
fairly alive with devouring interest, with

200 Absorbing Illustrations
that combine to make up one of the most interesting and instructive popular magazines ever published.

POPULAR ELECTRICITY AND THE WORLD'S ADVANCE
FOR OCTOBER
Now on Sale at Your Newsdealer's

You must see a copy to really appreciate its wealth of interesting features, but to whet your appetite for the good things awaiting you, glance at this brief summary of contents

MOTION PICTURE DEPARTMENT
Sixteen pages—presenting the latest photo plays and anecdotes and in addition taking you through all the fascinating details of motion picture production.

WORLD'S PICTURE GALLERY
History in the making, told in sixteen solid pages of striking photographs from all parts of the globe. Wonderfully interesting!

THE GREAT ELECTRICAL SECTION
It tells you in simple language the fascinating Story of Electricity. The various Departments and numerous special articles—all profusely illustrated—keep you in touch with electrical progress the world over, and vividly show the astonishing applications of this subtle force—facts of vital interest to everyone. The subject is covered from every conceivable viewpoint, appealing alike to the general reader, the student, amateur or practical man. This 64 page section, alone, constitutes a magazine replete with entertainment and instruction for every member of the family.

MANY OTHER LIVE ARTICLES—
devoted to modern progress in every line. 32 pages of vivid, living pictures and stories of the world in action today, the striking, worth while things that you like to know about—interesting—educational—uplifting. And this immense entertainment of *128 pages—200 subjects—200 illustrations*—awaits you in

POPULAR ELECTRICITY AND THE WORLD'S ADVANCE
for October, 15c a copy *Get It TODAY from Your Newsdealer* *for October, 15c a copy*

If your dealer cannot supply you send us his name and your own name and address with 15c in coin or stamps and we will mail you a copy, postpaid.

POPULAR ELECTRICITY PUBLISHING CO., 350 North Clark Street, Chicago

diameter; the low-pressure cylinders, 38 inches in diameter; the common stroke is 32 inches. The maximum draw bar pull is 111,000 pounds, and this locomotive has hauled 1,911 tons at 12 miles per hour over a 1.5 per cent grade.

Remarkable Giant Sea-anemone

(*Concluded from page 231.*)

fifth of a mile in depth; where a gleam of light never penetrates, where the temperature wanders down to the vicinity of freezing, and where the pressure is so great that all animals living there must be more or less adapted to such an existence; their systems being permeated with water to offset the pressure. When brought up it was inconspicuous. It attached itself to a bait, and when taken off, uninjured, resembled a ball of white flesh about the size of a small apple. When placed in a tank in the aquarium it remained inconspicuous for days. But one night the watchman in going his rounds, saw a splendid column of white over one foot in height and expanding as much more across the tentacles, looking, he said, like a miniature volcano; its fluted tentacles being pure white and resembling clouds against a dark sky. In the daytime the anemone reduced itself, by excluding water, to an unnoticeable bulk; at night gradually increasing in size by pumping in water, taking the shape of a graceful perfectly symmetrical pillar. Then the pure white tentacles would begin to appear and elevate themselves, a performance which I observed through the courtesy of the old soldier who is a night watchman at the little aquarium at Avalon. Gradually the anemone would rise in a miraculous manner like the mysterious plants of Persia under the hands of a fakir, until it stood firm and rigid, a splendid creature a foot or more in height and six or eight inches across the tentacles, which were pure white, suggesting the name "sea-ghost," given it by one of the men.

I was fortunate in observing the wonderful anemone, which might be called a sea-carnation, or used as a model by an architect when it reduced its size. This was accomplished by a sudden restriction midway, or a little above it, in the column which, apparently, forced a large amount of water from the column. The support thus removed from the enormous upper portion or tentacles, the latter fell over until they almost touched the bottom, and the anemone had the appearance of having been stricken, or struck down by a heavy blow. In a few moments the restriction increased and the pure-white fluted tentacles began to disappear, drawn into the body mass which now imperceptibly settled down upon itself, giving the observer the impression of being witness to a miracle, as the giant grew smaller and smaller until in a short time nothing could be seen of the splendors of a few moments before but an inconspicuous mound of flesh, but a few inches high, perched upon a water-worn pebble four inches long, clinging to it by the sucking disk possessed by most anemones.

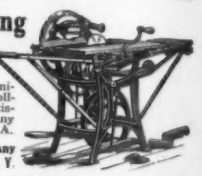
Fighting the Plague With Soap and Petroleum

THE authorities of the Dutch East Indies are continually fighting the danger of the plague, which threatens the communities especially in the harbor towns, where rats from the incoming vessels spread the disease germs.

Dr. Pijl, Government physician for the harbor of Soerabaja, has now found that a mixture of petroleum and soap, applied freely to the localities where the rats swarm, will effectively destroy their fleas and with them the plague bacilli. This new disinfectant is cheaper and more efficacious than carbolic acid.

A Patent for Shoe-last Machine.—Edward J. Prindle has had issued a patent, No. 1,069,173, dated August 5th, 1913, for a machine for making lasts, the application for the patent having been filed in the Patent Office August 14th, 1901.

Wood-Working Machinery



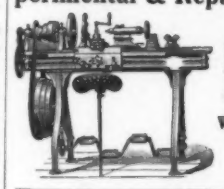
For ripping, cross-cutting, mitering, grooving, boring, scroll-sawing, edge moulding, mortising; for working wood in any manner. Send for Catalog A.

Seneca Falls Mfg. Company
695 Water Street, Seneca Falls, N. Y.

Good Lathes are the result of years of experience. Sebastian Lathes have been on the market 25 years.

13, 14 AND 15 INCH SWING—CATALOG FREE
THE SEBASTIAN LATHE CO., 120 Culvert St., Cincinnati, O.

***For* Gunsmiths, Tool Makers, Experimental & Repair Work, etc.**



From 9-in. to 13-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.

W. F. & J. Barnes Co.
Established 1872.
1999 Ruby Street
Rockford, Ill.

GROBET SWISS FILES
and other high-class Tools are shown in "THE TOOL-MONGER"—its 462 pages, and will be mailed on receipt of 8 cents in stamps.

MONTGOMERY & CO.
105 Fulton Street New York City

One sample to one person only. $1
Ask about our 3,000 R. D. Tools
"Red Devil"
SPECIAL
Heavy 'Klein' Pattern
Electricians' No. 1950
Side Cutting Plier, 8"
SMITH & HEMENWAY CO.
150 Chambers Street, New York City, N.Y., U. S. A.

WELL DRILLING MACHINES

Over 70 sizes and styles, for drilling either deep or shallow wells in any kind of soil or rock. Mounted on wheels or on sills. With engines or horse powers. Strong, simple and durable. Any mechanic can operate them easily. Send for catalog.

WILLIAMS BROS., Ithaca, N. Y.

UNIVERSAL SCRAPER

Neatest, simplest and best on the market. Eight sharp cutting edges, each brought instantly into use by ball joint connection. Sets at any angle. Easily locked or released by turning handle.

PRICE $1.00

Send for 274 page catalog, No. 19-B.

THE L. S. STARRETT CO., Athol, Mass., U. S. A.

NOVELTIES & PATENTED ARTICLES
MANUFACTURED BY CONTRACT. PUNCHING DIES.
LIGHT AUTOMOBILE STAMPINGS
E. KONIGSLOW STAMPING & TOOL WORKS, CLEVELAND, O.

Models and Experimental Work
INVENTIONS DEVELOPED
SPECIAL MACHINERY . . .
E. V. BAILLARD CO., 24 Frankfort St., N. Y.

WANTED To manufacture METAL SPECIALTIES, 20 years experience in making Dies, Tools and Special Machinery. Expert work. Complete equipment. NATIONAL STAMPING & ELECTRIC WORKS, Dept. 2, 412 So. Clinton Street, - Chicago, Ill.

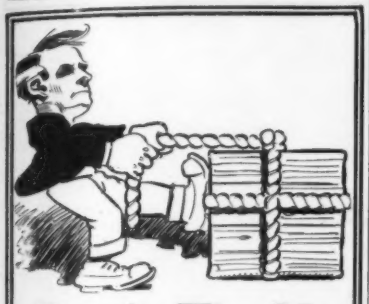
Patented Articles and Metal Specialties
MANUFACTURED BY CONTRACT
Stamping Dies, Metal Stampings and Screw Machine Work
H. CARSTENS MFG. CO., 567 W. Lake St. CHICAGO

A Home-Made 100-Mile Wireless Telegraph Outfit ¶ Read Scientific American Supplement 1605 for a thorough clear description, by A. Fred'k Collins. Numerous adequate diagrams accompany the text. Price 10 cents by mail. Order from your newsdealer or from
MUNN & CO., Inc. 361 Broadway, New York

HELHETOIL LUBRICATES ANYTHING SEND FOR SAMPLE FREE
118-124 North Clinton St.
CH. BESLY & CO. CHICAGO, U.S.A.

FROM NOTHING TO NINE MILLIONS

a year in sales was the result of using a certain selling method by one American house. Many others have done better. Read all about this method itself in the new book, "The Premium System of Forcing Sales: Its Principles, Laws and Uses," by Henry S. Bunting, who spent six years investigating this subject. The book will be sent you absolutely free with a year's subscription (two dollars) to The Novelty News, the magazine for the advancement of selling methods, 220 S. Market Street, Chicago.



Don't Tie Up Your Output

Don't worry and don't hold up your production because of work you haven't facilities to handle. And don't invest in special machinery which will be idle a goodly part of the time and will therefore pile up your overhead and eat into your profits.

Tie Up To G.P.&F. Service

It puts at your disposal 15 acres of modern special automatic sheet-metal machinery and an exceptionally competent force of trained operators. We can make your sheet-metal parts for you at less cost to you than if you made them yourself, for our machines are never idle and our overhead is minimized. And our deliveries are always prompt to the dot.

Our estimates are our proof that we can save you money. Send us either complete specifications or sample and state the quantity you will require. Our estimates will follow quickly. Why not send them today?

We are specialists in

Stamping

Drawing and Spinning in Brass, Copper, Aluminum, Tin, Monel Sheet, and Steel. The heavier the part or the more difficult the stamping, the better we can serve you. We are also thoroughly equipped to do

Porcelain Enameling

Japanning, Tinning, Hot Galvanizing, and any Description of Job Work. Try us once and you'll use our service always.

Geuder, Paeschke & Frey Co.
1325-1700 St. Paul Ave., Milwaukee, Wis.

For Younger Readers

Harper's Aircraft Book for Boys
By ALPHEUS HYATT VERRILL

EXPLAINS in a simple, lucid manner, the principles and mechanisms involved in human flight, and tells how to design and construct model aeroplanes, gliders and man-carrying machines. The author's purpose has been to furnish a book on air-craft not only accurate, but simpler, more comprehensive and up to date than anything yet written. Instead of mere theories, here are actual facts and results, the experiences of noted aviators and builders.

$1.00 NET

Harper's Beginning Electricity
By DON CAMERON SHAFER

THIS book is an introduction to electricity, carefully planned to avoid the difficulties so often met with in scientific books for young readers, and is direct and convenient in its application. Simple explanations are given for experiments and devices which every boy will love to make. There is a brief outline of the history of electricity and directions for making batteries and permanent and electro-magnets. Among the chapters are ones devoted to the telegraph, telephone and the electric motor, and to static, galvanic electricity and dynamic electricity, etc.

$1.00 NET

Joe, the Book Farmer
By GARRARD HARRIS

IN this story of the success of the champion boy corn-raiser of his State, the author points out a new field for youthful ambition. It is a sort of book that makes you wonder why it has not been written before—the romance of promise for the poor country boy who sees the miracles intelligent labor can bring about. The story, with its mixture of information and interest, will stir every country boy to emulation; and city youngsters will enjoy the descriptions of Southern life—the bear, deer, and coon hunts, barbecues, shooting, fishing, and sugar-making.

$1.00 NET

HARPER & BROTHERS

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12854) E. P. asks: An article on "The Determination of Longitudes by Wireless Telegraphy," appearing in the current issue of the SCIENTIFIC AMERICAN, was very interesting. I ask the following questions by way of information: 1. The author says in reference to the velocity of propogation of Hertzian waves, "so far no true determination has ever been attempted." Is it not true that Hertz measured the velocity of electromagnetic waves and showed it to be nearly equal to that of light? (Ganot's Physics, page 1111). As I understand it he measured the wave length with a form of resonator by the node method and deduced the velocity from this and the vibration rate. Was his method of obtaining this rate the use of the theoretical formula $t = 2\pi\sqrt{LC}$? Has this formula ever been independently verified experimentally? A. We see no reason to object to either your statement or to that of the article to which you refer as to the velocity of Hertzian waves. Hertz probably did not suppose he had made an exact determination. As you say he showed that it was "nearly equal" to the velocity of light. The author says in his article: "No true determination," that is, no exact determination has been made. It may ultimately be found that the velocity of Hertzian waves varies with varying conditions. We cannot say whether the theoretical formula has been verified. 2. The distance over the earth's surface between Washington and Paris as deduced from their geographical positions given in the Nautical Almanac is 3,832 miles. Taking the velocity of Hertzian waves at 186,000 miles per second, the time of transmission is 1/48.5th of a second. Is not this far within any personal error of observation of the clock stars? Will not this quantity be lost in the personal and instrumental errors? A. When the *exact* determination of velocity shall be made it cannot be dependent upon personal observation but must be recorded independently of the senses of the operator, otherwise it cannot be exact. 3. Has it ever been shown that the speed of light has any relation to the wave length, i. e., that red light has a different velocity from blue light in a vacuum? Where can a full account of Hertz's experiments be found? A. The different wave lengths of solar radiation are considered to traverse space with the same velocity. We do not know any full translation of Hertz's work in English. However, a fair presentation is given in Maxwell's "Theory and Wireless Telegraphy," by Poincaré, translated by Vreeland, price $2, and in "Electrical Waves," by Hertz himself, price $2.50. Fleming's "Principles of Electric Wave Telegraphy," price $7.50 is the standard work in English. We send these books at the price named and shall be pleased to receive your order.

(12855) H. R. asks: I would like your opinion as to what would be the height of a mountain and where would be found the freezing point here in Porto Rico? A. The observed decrease of temperature with the altitude is, according to Waldo, on the average, about 1 deg. Fahr. for 330 feet of ascent into the air. From this number the approximate height at which the freezing point is reached may be computed. It must be said that the matter is not definitely settled. The difference is not the same at different times in the year. It is not the same for all places nor for the same place at all times. A great diversity of results has been reached by those who have climbed mountains and ascended in balloons. Theoretical considerations lead to the conclusion that there should be a decrease of 1 deg. Fahr. for each 183 feet of ascent, which is a much more rapid fall of temperature than is found actually to exist. Indeed, it frequently occurs that for a short distance there is an increase of temperature with the increased altitude.

(12856) L. T. C. asks: Would you please tell me through your "Query" column if the north magnetic pole is *positively* or *negatively* charged? Would not the opposite charged point of a compass be attracted by this pole? Could this be tested out if the compass is taken in connection with electro-magnets providing you are sure if the electro-magnets are positively or negatively charged? If this is not a practical method would you please tell me one? A. The kind of magnetism at the north magnetic pole of the earth is the opposite to that in the north pole of a magnetic needle. This is so because the needle is attracted to the pole and unlike poles attract each other. This is accepted by everyone and needs no further proof than is given by any two suspended needles. The north poles of two magnetic needles repel each other, and the south pole of one attracts the north pole of the other. Hence, the magnetism which is in the north magnetic pole of the earth is of the same kind as that which is in the south pole of the magnetic needle.

NEW BOOKS, ETC.

FINDING THE WORTH-WHILE IN EUROPE. By Albert B. Osborne. New York: McBride, Nast & Co., 1913. 12mo.; 240 pp.; illustrated. Price, $1.40 net.

In spite of the width of territory necessarily covered in a very few pages, this condensed guide vindicates its title, and will prove of immense help to him who is more interested in national characteristics and out-of-the-way beauties than in the cities and show places of Europe. Mr. Osborne has the faculty of bringing places vividly and, what is more to the point, accurately before us by the apt word or phrase, the felicitous turn of expression. If the one map given had been drawn to a larger scale, it would have enhanced the value of the work and saved the eyesight of the reader.

PRACTICAL PHYSICS FOR SECONDARY SCHOOLS. Fundamental Principles and Applications to Daily Life. By N. Henry Black, A.M., and Harvey N. Davis, Ph.D. New York: The Macmillan Company, 1913.

While this textbook follows the general line of similar modern productions, it differs from most of them because it relies for its analogies on the working of devices with which most of us are thoroughly familiar, electrical machinery, optical instruments, ships, automobiles and the like. The expedient of requiring the student to work out problems after the fundamental principles have been explained to him is also adopted in this book. In the framing of the problems, the authors give evidence of their experience as teachers; for the problems are arranged systematically in the order of their difficulty. The treatment of acceleration, Newton's laws, kinetic energy and momentum, differs from that to be found in most physics text books. In this treatment a concrete instance from everyday life is usually included. Thus, under the heading *Acceleration*, we read: "It is unpleasant to be on a street car when it stops or starts too suddenly. This suggests the problem of measuring a rate of change of speed, which is called acceleration. It has been found that a city street car standing at rest can safely gain speed, so that at the end of ten seconds it is going 15 miles per hour. Assuming that this gain in speed is made at a constant rate, the speed of the car increased 1.5 miles per hour every second. In other words, the acceleration was 1.5 miles-per-hour per second. Or, since 15 miles an hour is 22 feet per second, we can say that the gain in speed each second is 2.2 feet per second." Thus, the fact that acceleration may be expressed as so many speed units per time unit is driven home. This has distinct advantages over the dyne and poundal method usually taught.

JESUS CHRISTUS UND SEIN STEM. Eine Chronologische Untersuchung von Arthur Stentzel. Hamburg: Verlag der Astronomischen Korrespondenz, 1913.

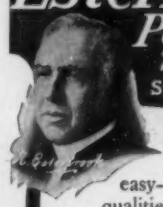
The author of this book has given us a chronology of the life of Christ, on the basis of such scientific facts as can be unearthed in historical and other literature. After a brief introduction, he endeavors to fix the exact date of the crucifixion, by calculating among other things, the date of the Last Supper, the calendar day of the crucifixion, the earthquake, and the Julian date of the crucifixion. In endeavoring to fix the date of Christ's birth, the author considers the utterances of the apostles, the massacre of the Innocents and the flight into Egypt and similar data. The star of Bethlehem naturally also plays its part in these studies. The author decides that the star must have been a comet, since the celestial phenomenon observed by the wise men cannot be explained by any other hypothesis. He decides that the star of Bethlehem was no less a body than Halley's comet, a decision with which most astronomers would not be likely to agree. He places the birth of Christ at September 17th in the year 12 B. C. and the crucifixion at April 3d, A. D. 33.

THE RESISTANCES OF THE AIR AND AVIATION. Experiments Conducted at the Champ-de-Mars Laboratory. By G. Eiffel. Second edition revised and enlarged. Translated by Jerome C. Hunsaker, Assistant Naval Constructor, U.S. Navy. Boston and New York. Houghton-Mifflin Company, 1913. Price, $10 net.

This second edition of Mr. Hunsaker's translation of the work in which that gifted and remarkable octogenarian, Gustave Eiffel, has presented the results of his long study of aerodynamic problems, speaks well for the interest which this country is taking in the theoretical side of aviation. The work of Eiffel has been so thoroughly discussed in the columns of the SCIENTIFIC AMERICAN that it seems unnecessary to dwell upon it here. This work represents Eiffel's maturest experience and conclusions in aerodynamical research. It forms, indeed, a worthy monument to his liberality and scientific spirit, as also to the skill of himself and his associates. Two classes of wind objects were studied: those of exact geometrical form and those of unmathematical figure. The exact geometrical forms comprised planes, circularly arched plates, cylinders, cones, etc. The other shapes were patterned after well-known aeroplane wings.

One of Eiffel's greatest services to aerodynamics is his study of the point pressure of the air on models not only at one portion of their surface, but at every portion where it is unknown or cannot be inferred from symmetry, thus furnishing a complete map of the pressure distribution. For practical availability and thoroughness, Eiffel's memoir is one of the finest that has yet appeared in aerodynamics.

Esterbrook Pens
250 styles



The smooth, easy-writing qualities, long wear, and ability to hold a large quantity of ink, are some of the things that have helped to make Esterbrook's Jackson Stub No. 442 the most popular of all stub pens.

Write for illustrated booklet.

Esterbrook Pen Mfg. Co.
New York Camden, N. J.

Ask your stationer

"Just apply and heat"
Use iron or torch
No acid-no rosin
Alcohol Torch and 50c can
TINOL Paste Postpaid $1

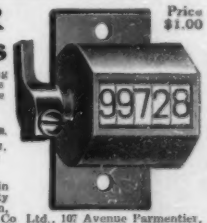
SO EASY TO SOLDER WITH TINOL

the modern combined solder and non-acid flux
Paste and wire forms
Mends kitchen-ware instantly-A hundred uses in home, shop and laboratory
HESS & SON, Dept. A, Watkins Bldg., Phila., Pa.

The Giant Heater
WILL HEAT ANY ORDINARY ROOM IN ZERO WEATHER AT ALMOST NO COST

Applied to central draught lamp or gas jet (naked flame or mantle burner).
HEAT AND LIGHT AT ONE COST
Mr. H. P. Howe, 712 2nd Ave., S.E., Minneapolis, Minn., writes: "Giant Heater is a perfect success; I would not be without it in my home."
Price Complete, Charges Prepaid.
BRASS, $1.50; NICKEL PLATED, $2.00
Attractive Illustrated Booklet Mailed Free
THE GIANT HEATER CO., 98 Temple Street, Springfield, Mass.

VEEDER Counters
to register reciprocating movements or revolutions
Cut full size. Booklet free
VEEDER MFG. CO.
18 Sargent St. Hartford, Conn.
Cyclometers, Odometers, Tachometers, Counters and Fine Castings.



Price $1.00

Represented in Great Britain by Markt & Co. Ltd., 6 City Road, Finsbury Sq., London, E.C.; France, by Markt & Co Ltd., 107 Avenue Parmentier, Paris; Germany, Austria-Hungary and Scandinavian Countries by Ludw. Loewe & Co., Hutten Strasse 17-20, Berlin.

Shirley President Suspenders
50¢
Support for clothes—ease for shoulders
"Satisfaction or money back"
Be sure "Shirley President" is on buckles
The C. A. Edgarton Mfg. Co., Shirley, Mass.

LEARN TO BE A WATCHMAKER
Bradley Polytechnic Institute—Horological Department
Peoria, Illinois
Largest and Best Watch School in America
(This entire building used exclusively for this work)

Formerly Parsons Horological Institute

We teach Watch Work, Jewelry, Engraving, Clock Work, Optics. Tuition reasonable. Board and rooms near school at moderate rates. Send for Catalog of Information.

ROTARY PUMPS AND ENGINES
Their Origin and Development

An important series of papers giving a historical resume of the rotary pump and engine from 1588 and illustrated with clear drawings showing the construction of various forms of pumps and engines. 38 illustrations. Contained in Supplements 1109, 1110, 1111. Price 10 cents each. For sale by Munn & Co., Inc., and all newsdealers.

Stop Forgetting!

Good memory is absolutely essential to success, for *memory is power*. Be successful—*Stop Forgetting!*
The Dickson Method of Memory Training makes you "*Forget Proof*," develops will, self-confidence, quick thought, ready speech. Write for free book "How to Remember"—faces, names, studies, also how to secure *FREE*, my $2 DeLuxe book, "How to Speak in Public."
Dickson Memory School 703 Auditorium Bldg. Chicago

EFFICIENCY IN RETAILING
Send for free catalogue on retail advertising, window trimming, mercantile decorating, retail salesmanship and show card writing.
ECONOMIST TRAINING SCHOOL
231-243 West 39th Street, New York City

DELCO

ELECTRIC CRANKING LIGHTING IGNITION

The Nineteen Fourteen Delco

Delco equipment for 1914 marks probably the highest type of electrical apparatus ever made for motor car service.

Recognition of this superiority is found in the fact that our entire output for this year amounting to 100,000 equipments has been sold and we are still unable to meet the demand.

The 1914 Delco is simpler and more compact in construction.

It is higher in power and quicker in operation.

And—if such a thing is possible—it is more effective.

It is the Refined Delco—fundamentally and mechanically the same as the first Delco System—yet a somewhat more perfect product—due to the experience gained in the production of more than 50,000 Delco Equipments now in use.

And it is as dominantly in the lead today as it was two years ago, when for the first time Delco Equipment made the electrically cranked car possible.

And now get this thought firmly fixed in your mind.

Delco equipment occupies a dominant position today, not simply because of its ability to crank an engine—

Any electric motor properly attached to a car will do that so long as it has a full battery from which to draw current—

The Delco System is a success because it cranks a car in demonstration—and then keeps on cranking it in actual day after day service.

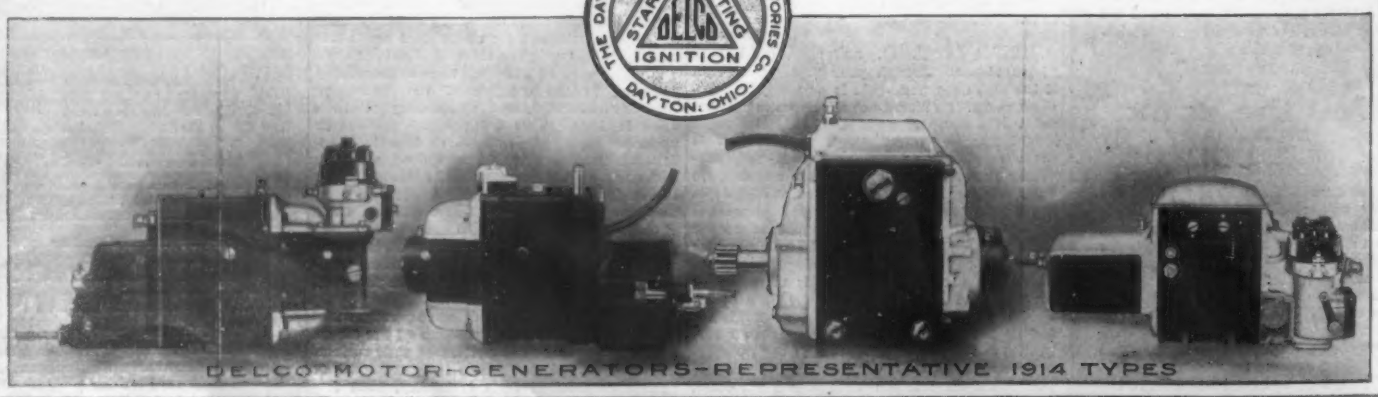
But even that is only half the story—the vital element in successful electrical equipment is current control—the battery must be kept fully charged all the time—no matter whether the car is driven fast or slow—no matter whether much or little current is used for cranking, lighting and ignition—there must always be a fully charged battery from which to draw more current.

Delco engineers have solved this vital problem.

Thousands of Delco equipped cars that have been in use for one to two years have never been hand cranked; neither battery nor motor has ever failed to respond when called upon.

That is why the Delco System has been selected by many of the foremost motor car manufacturers of America as standard equipment for their cars.

That is why Delco Equipment has come to be about the biggest selling asset that a car can have.



DELCO MOTOR-GENERATORS—REPRESENTATIVE 1914 TYPES